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7 AUGUST 1986

China Report

ECONOMIC AFFAIRS

ENERGY: STATUS AND DEVELOPMENT--51

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NATIONAL POLICY

IMPACT OF FALLING OIL PRICES ON NATION'S ECONOMY ANALYZED

HK030405 Hong Kong LIAOWANG OVERSEAS EDITION in Chinese No 21, 26 May 86 pp 6-7

["Roundup" by staff reporter: "What Has the Steep Fall in Oil Prices Brought to China?"]

[Excerpts] What is the trend of oil prices in the world market? What will it mean to China's economy? What measures will China take to deal with it? Many people in the country and abroad are concerned about these questions. For this reason, LIAOWANG invited some editors and reporters responsible for international and domestic economic reports to study the above questions. They were Jiang Hong of the international news section of XINHUA, Yu Quanyu and Chen Naijin of its domestic news section, and Yang Changming of JINGJI CANKAO [ECONOMIC REFERENCE].

The Influence of the Fall in Oil Prices on China's Economy

The fall in oil prices has affected China in three ways:

--It has affected China's foreign exchange earnings. Last year, the selling price of China's export crude oil was between $23 and $24 per barrel. A drop of $1 in the price of oil causes a decrease of $200 million in state revenue. The decrease in the export of crude oil this year is estimated at between $2 and $3 billion.

--It has affected China's export of labor services. In recent years, rapid development has been noticed in China's export of labor services, and particularly in its export of labor services to the oil-producing countries in the Middle East. However, due to a sharp drop in oil prices, these oil-producing countries have promulgated laws, decrees, and regulations restricting labor services from abroad.

--It has affected China's imports and its work of introducing foreign technology. Statistics suggest that China's foreign trade deficit amounted to $7.6 billion last year. This year, there will be a drop in foreign exchange earnings through oil exports, and imports will also be affected.

There Are Advantages and Disadvantages

The sharp fall in world oil prices has, of course, produced a strong impact on China's economy. However, this impact is not too serious. We can say that there are advantages and disadvantages.

From the short-term viewpoint, a decrease of $2 to $3 billion in foreign exchange earnings is a serious loss, but the income from the export of oil accounts for only one-fifth of the country's foreign trade earnings. It is a small figure. Using some of the export oil for the production of export commodities will help the enterprises concerned improve their ability to increase foreign exchange earnings, as the country is now short of energy. Moreover, the world market has been enlivened as a result of the fall in oil prices. This has provided favorable conditions for China to expand its exports. An example was the Guangzhou Spring Commodities Fair, where business transactions hit an all-time high. In addition, the decrease in foreign exchange will encourage the country to reduce imports and save funds. In the first 4 months of this year, the country's foreign trade deficit was $939 million, much lower than that in the same period last year.

From the long-term viewpoint, the fall in oil prices has also constituted a challenge to China's economic and foreign trade structures. In this situation, if China makes up its mind to carry out self-readjustment--to readjust its policies on energy and technical transformation and to readjust the mix of its foreign trade products so as to keep pace with the new situation in world economic development--it will be able to speed up the process of modernization.

Measures China Should Take

The participants discussed the measures China should take to cope with the fall in oil prices and were of the opinion that attention should be paid to the following points:

--It is necessary to reform China's foreign trade structure so as to improve its adaptibility. Under China's existing foreign trade structure, production is not linked to marketing, the transmission of information is sluggish, and feedback is lacking. All this does not match the changeable situation in international trade. As a result of the fall in oil prices, our old practice is no longer suited to the international market. Therefore we should reform our foreign trade structure in such a manner that it is outward-oriented, flexible, and sensitive. In this way, we will be able to increase our foreign exchange earnings and improve our adaptibility.

--In the course of readjusting the mix of export commodities, it is wise to exploit oil resources energetically and continue oil exports. As China does not have the problem of overproduction of oil, it should develop its oil industry resolutely. As to the export of oil, it is recommended to reduce for a period of time. But from a strategic and long-term viewpoint, it is necessary to maintain a certain amount of oil exports.

--It is necessary to improve and develop tourism so as to make up for the decrease in foreign exchange earnings resulting from the fall in oil prices.

The fall in oil prices has led to economic optimism in the West and prosperity in international tourism. Because Western Europe is under the threat of terrorism and due to a nuclear plant accident in the Soviet Union, Western tourists are becoming more interested in China, where there are safe scenic spots, cultural relics, and unique customs and habits. In recent years, tourist facilities in China have increased by a large margin, and a sure foundation has been laid for the further development of tourism. It is certain that more visitors will come to China, so long as we turn out more qualified guides, make good traffic arrangements for tourists, and rapidly improve the quality of service.

--As foreign interest rates are dropping, we should take this opportunity to obtain more commercial loans. Interest rates have dropped in many countries following the fall in oil prices in the international market. U.S. interest rates have dropped to the lowest point since Reagan assumed office. China should strive to get more commercial loans on condition that it has the ability to repay. Also, it should try to issue commercial bonds through bank guarantees so that it can import the technology and materials it urgently needs.

/12712
CSO: 4013/132

NATIONAL POLICY

WORLD BANK LOANS GIVE BOOST TO ENERGY SECTOR

HK040440 Beijing CHINA DAILY in English 4 Jun 86 p 2

[Text] China will use three World Bank loans totalling $307 million to develop its energy sector. Two of the projects are in the power subsector, while the third involves petroleum appraisal and technical assistance.

A loan of $225 million aims to support industrial growth in east China by estalbishing a base-loan thermal power plant along the coast of Zhejiang Province. The project will relieve electricity shortages in east China, which accounts for about 25 percent of total national industrial production.

A coal-fired thermal power plant will be built at Beilungang, using coal from Shanxi. The plant will include facilities for unloading coal and will set standards for similar facilities to be built in the future. It will have two generating units of 600 megawatts each, two 500 kilovolt transmission lines, and associated substations. The project also includes a training program and a tariff study.

Ebasco, a U.S. company, has been appointed as the consulting engineering firm for the project. Co-financing amounting to $156 million through commmercial bank loans or export credits is being considered for a second unit of major equipment items. Loans totalling $663.9 million from local banks will complete the financing for the project.

A second loan of $52 million from the World Bank will support economic growth in south China through the "cascade end" development of the Hongshui [He]. The project comprises the construction of a 110-meter dam, a spillway, a powerhouse, and locks. It also includes the installation of four generating units of 275 MW each, the construction of two 500 kV transmission lines, and three associated substations. Consulting services for design and construction management, as well as a training program are also included. The Government of Norway has agreed in principle to provide for consulting services in construction management through a grant of about $2 million.

The project will introduce state-of-the art dam construction techniques, provide a link between the Yantan Power Station and south China, and help to strengthen and update the financial planning and management practices of the Guangxi Electric Power Bureau.

Additional funding for the project will come from local banks, which will provide loans totalling $979.1 million.

A $30 million World Bank loan will assist in the appraisal of Bohai Oil Corporation's [BOC] oil and gas condensate discovery in Liaodong Bay in northeast China. The appraisal will comprise seismic data processing, well-drilling and testing, and special tests and studies relating to the Jinzhou 20-2 structure, discovered in 1984. The project will also assist in the planning and financing of an optimum programme for developing the discovery and in strengthening BOC's capabilities in offshore petroleum operations by providing technical assistance, training and equipment.

The appraisal programme is essential to an assessment of the production potential of the Liaodong Bay area, and particularly to ensuring the technical, economic and financial soundness of the proposed development of the Jinzhou 20-2 structure. It could open also the door to private equity participation in the area by international oil companies or other financial partners.

In addition to the World Bank loan, additional funding will come from a bilateral credit ($15 million) and BOC's resources ($33.8 million).

/12913
CSO: 4010/57

TAILORING RURAL ENERGY DEVELOPMENT TO CHINA'S UNIQUE SITUATION

Beijing NONGCUN GONGZUO TONGXUN [RURAL WORK NEWSLETTER] in Chinese No 5, 5 May 86 pp 36-37

[Article by the Office of Rural Energy and Environmental Protection, Ministry of Agriculture, Animal Husbandry and Fishery: "The Road and Measures for Rural Energy Development in China"]

[Text] The energy sources in China's rural areas include small hydroelectric power stations, small coal mines, fuel forests, methane and fuel-saving stoves as well as exploitation and utilization of such natural resources as solar, wind, geothermal and tidal energy. Rural energy development is an important part of rural work, and the advance force for rural economic development. It not only concerns the well-being of 800 million peasants and agricultural production, but has a bearing on achieving the goal of having the Chinese people become "relatively well-off" and on improving the rural ecological environment. Therefore, leading comrades of the CPC Central Committee and the State Council have said repeatedly that serious attention should be paid to rural energy development, regarding it as a strategic matter.

As in other developing countries, 80 percent of the Chinese population lives in the countryside, and energy use is scattered on a household basis. Per capita energy consumption is low, waste is high, and ways of energy use are primitive and backward. Most peasants are used to direct burning of stalks and firewood, and in some places even animal droppings are used as fuel. With the rapid development of the rural commodity economy in the past few years, the peasants have begun to change the simple and backward energy structure and demand high-grade fuels in daily life and production. Moreover, China is a big country, and rural energy resources are plentiful but unevenly distributed and very different from place to place. In some places it is feasible to develop small hydroelectric power stations, methane, and geothermal energy; in other places it is suitable to develop wind and solar energy; and in still other places it is possible to develop all kinds of rural energy resources. China's rural energy development should proceed from local conditions and follow a road of rural energy development with Chinese characteristics.

Judging by practice in the past few years, this road consists mainly of the following aspects:

1. Rational utilization of natural resources and preservation of a good ecological environment by adopting measures suited to local conditions and using different energy sources to supplement one another. Rural energy development should focus on rational use of renewable energy resources and aim at preservation of a good ecological environment. And in view of the distributional and seasonable limitations of various kinds of renewable energy resources, it is necessary to make use of them in a mutually supplementary way. Vigorous efforts should be made to develop small hydroelectric stations in the coastal areas, promote the use of methane in the Chang Jiang and Huai He river valleys and southern provinces, and develop small coal mines, fuel forests and wind and solar energy in the Huang He river valley and the northwest region.

2. Putting equal stress on increasing supply and reducing consumption, meeting both household and production energy demands. Attention should be paid to the power demands of both villages and small towns; while individual households are encouraged to produce their own energy, attention should also be paid to central energy supply sources; while putting the stress on small and medium-sized installations, attention should also be paid to large construction projects.

3. Multipurpose use holds the key to increasing economic benefits. Rural energy development is a part of social development, and its social and environmental benefits are far greater than the value of energy itself. The state should proceed from the macroeconomic results in formulating rural energy policies, while the peasants set sight on the microeconomic benefits. It is necessary to vigorously promote multipurpose use in order to induce the masses to produce energy voluntarily and with their own funds.

4. Rural energy development must be combined with the development of rural towns and civilized villages under unified planning and implemented simultaneously.

By following this road for rural energy development, China's rural energy structure will improve continuously, adapt itself to local conditions and changing times, and gradually fall into a pattern, standardized and systematized, enabling the ecological environment, agriculture, rural economy and rural society to develop toward a bright future.

To do a good job in developing rural energy resources and promote the building of the two civilizations in the countryside, we should adopt the following measures:

1. Rural energy development is a new social development task, and its macroeconomic benefits are greater than its microeconomic benefits. Because of this, we must give greater publicity to its strategic significance and related principles and policies. First of all, as pointed out by Comrade Li Peng, from the central ministries and commissions to the leadership at the local level, it is necessary for everyone to pay attention to solving the rural energy problem, starting from increasing understanding of it.

2. Rural energy involves many departments. It is necessary on the one hand to heighten the enthusiasm of the related departments to work in concert in developing energy resources, and on the other to properly coordinate their efforts on the basis of a clear division of labor. The Economic Commission is responsible for coordinating rural energy work, and is in charge of the energy industry, pilot and demonstration projects and other general tasks. The Planning Commission is responsible for policy and planning work. The Science and Technology Commission is in charge of related scientific and technological work. The Ministry of Water Resources and Electric Power is in charge of the small hydroelectric power stations. The Ministry of Forestry is in charge of the fuel forests. The Ministry of Agriculture, Animal Husbandry and Fishery is in charge of methane, fuel-saving stoves, agricultural application of solar, wind and geothermal energy, energy conservation in agricultural production and so forth, and also helps the Economic Commission in coordination work. Major rural energy problems will be discussed and solved by the State Council's energy conservation meetings.

3. It is necessary to strengthen the rural energy industry, improve the service system, set up a maintenance and repair network and examining centers for different products, promote all-round quality control and pay attention to the production of standardized, seriated and interchangeable energy equipment and products.

4. Greater efforts should be made to solve major technological problems about renewable energy sources and to turn research results into productive forces as quickly as possible. Technological research in this area will be coordinated by the Economic Commission, and the participating units include the Ministry of Agriculture, Animal Husbandry and Fishery, which has the major responsibility, the Ministry of Forestry, the Ministry of Water Resources and Electric Power, the Ministry of Machine-Building Industry, the Chinese Academy of Sciences and the Education Commission. It is necessary to strengthen international exchanges and upgrade our rural energy development technology. It is necessary to make vigorous efforts to train professional people and increase investment in the development of intellectual resources.

5. It is necessary to make full use of the existing energy equipment of all kinds, increase their rate of actual utilization, and replace, repair and renovate the existing equipment, installations and technologies in a planned way by stages and in groups.

6. It is necessary to improve our work style, raise our organization and management standards, tell the truth, do solid work, produce real results, and conduct various kinds of experimental work in a down-to-earth manner, so that the road for rural energy development with Chinese characteristics will become increasingly broader.

12802/12859
CSO: 4013/133

NATIONAL POLICY

RURAL ELECTRIFICATION EFFORT MAKES SUBSTANTIAL GAINS

6th FYP Construction Recapped

Beijing NONGMIN RIBAO in Chinese 11 Mar 86 p 2

[Article by reporter Chen Daian [7115 0108 1344]: "Rural Energy Construction Record During 6th FYP Outstanding"]

[Excerpts] With daily life and production as its principal objectives, rural energy construction during the period of the Sixth Five-Year Plan [FYP] made significant achievements. Based on the statistics of the departments concerned, fuel forests increased by 35 million mu and 2,500,000 kilowatts of small-scale hydroelectric power generator capacity was added. The use of wood stoves spread to 40,000,000 households in the province and households using methane gas increased by 2,500,000. Solar stoves totalled 100,000 and there were 250,000 square meters of solar water heaters. Windmill power generating capacity increased to 530 kilowatts and over 70 geothermal sources were developed. Under certain conditions, the masses' concern over cooking fuel shortage has been alleviated while forests were protected, pollution reduced, and the health of the people improved.

During the 6th FYP, China achieved significant results in rural energy, developing a rural energy development plan to comply with the actual situation and on the basis of the investigation of and delineating the development of natural resources. This in turn spurred the promotion of energy-saving wood- and coal-burning stoves as well as better health standards stemming from rural use of methane gas and consolidated gas supply at the township and town level. Next, many provinces, autonomous regions, and municipalities directly under the central government have placed rural energy construction on their agenda, also taking it as a significant part of the two cultural buildups, specifically helping to solve personnel, talent, material, and other problems.

Model demonstrations were also used in many areas, promoting science and technology; establishing promulgation, scientific research, training, production, and service systems; and setting up and strengthening management agencies in all areas. Nationwide, there are already 20 provinces, autonomous regions, and municipalities directly under the central government which have established rural energy offices, and prefectures and counties have also established permanent agencies. Many districts and townships have specialized cadres, forming

a preliminary promotion body. More than 60 scientific research units, technical schools and research institutes nationwide are conducting scientific research in methane gas, fuel-efficient wood stoves, solar power, and geothermal energy, to strongly promote rural energy construction.

Accelerated Construction Urged

Beijing NONGMIN RIBAO in Chinese 11 Mar 86 p 2

[Commentary by reporter of this paper: "Diligently Accelerate Construction Work for Rural Electrification."]

[Excerpts] In recent years, the manifestation of the masses' "No need to worry about what's in the pot, just worry about what's under it" (a fuel shortage rather than a food shortage) may be gradually corrected. This news was elicited recently by reporters from the Ministry of Water Resources and Electric Power. Speaking only of the 100 counties nationwide which are pilot projects for electrification, 95 counties have "Substituted electricity for firewood," so that 380,000 rural households can use electricity for cooking during half the year when water is abundant.

Active development of small hydroelectric power capacity and the realization of rural electrification will affect establishment of China's rural modernization, particularly with respect to major problems with strategic implications in speeding construction in old, young, mountainous, border, and poverty-stricken areas. In recent years, with our agricultural villages at the turning point from traditional agriculture to modern agriculture, the effect of electricity has been truly outstanding. This point has been sharply emphasized by the building of the 100 pilot counties. First, the development of electrification has greatly improved the capability for agricultural drainage and irrigation as well as for agricultural byproduct fabrication. In these 100 counties, the rate of agricultural use of electricity in 66 counties is already over 90 percent. Next, the development of local industry and township and town enterprises has been speeded up. For example, in Zhuning County in Sichuan Province, the power supplied to township and town industries has increased by 4.6 million kilowatt hours, leading to new production worth 40 million yuan. In addition, the area in which the rural population uses electricity has expanded. Based on statistics, last year the consumption of electricity in the 100 pilot counties was 3.8 billion kilowatt-hours, 115 kilowatt-hours per capita. Throughout China there are now nearly 20,000 townships using power supplied by small hydroelectric power [sources], or 40 percent of all townships.

With the many wide-spread areas involved in rural electrification construction which affect thousands of families and tens of thousands of households, the direction of development must place principal dependence upon localities' and the masses' self-reliance. Practical experience during recent years has proved that accumulating capital through many channels, arranging power [electrification] at multiple levels, is the course to follow in achieving rural electrification. According to program budget estimates for the 100 pilot counties completion of the preliminary electrification tasks will require average annual funding of 600 million yuan. The State will provide a share of the capital but more will have to come from the localities' active raising of funds.

8174/13045
CSO: 4013/111

SEVENTH FYP ENERGY OUTPUT OFF TO GOOD START

OW030212 Beijing XINHUA in English 0056 GMT 3 Jun 86

[Text] Beijing, 3 Jun (XINHUS)--Increased output of coal, electricity and oil over the past 5 months is a "good beginning" for China's Seventh Five-Year Plan (1986-90), a senior official at the State Economic Commission said today.

In the first 5 months of this year, China produced 300 million tons of coal, 350 million bbl of crude oil and 170 billion kWh of electricity, said Shen Longhai, deputy director of the commission's energy bureau.

The increase, compared with the same period of last year, was less than 2 percent for coal and oil, and 7.5 percent for electricity, Shen added.

Nevertheless, shortages of power remain acute, he said, and the output of coal mines operated by local authorities suffers from inadequate transport capacity.

/12624
CSO: 4010/56

POWER NETWORK

ELECTRIC POWER CONSTRUCTION NOW AT 'UNPRECEDENTED' LEVEL

Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 13 May 86 p 1

[Text] Beijing, 12 May (XINHUA)--Since the beginning of this year, electric power construction has developed in all parts of the country on an unprecedented scale.

At present, four large hydroelectric power stations at Lubuge, Tianshengqiao, Yantan, and Dahua on the Hongshui He in south China are under construction simultaneously; construction of the Shijingshan power plant in Beijing is in high gear; a number of new projects including the Shidongkou power plant in Shanghai, the Pingxu and Luohe power plants of the Huainan coal mine area in Anhui, the Zouxian and Shiheng power plants in Shandong, the Tongjiezi and Baozhu hydroelectric power stations in Sichuan, and the Shuangyashan and Harbin No 3 power plants in Heilongjiang are under construction; the Dongjiang and Ankang hydroelectric power stations in Hunan and Shaanxi respectively will close their sluice gates to store water this year; and construction has also begun on China's first nuclear power projects, the Qinshan and Daya Bay nuclear power plants in Zhejiang and Guangdong respectively.

To give priority to power projects to ease the serious power shortage, the state plans to increase power generating capacity by 60-65 million kilowatts in the next 5 years, of which installations with a total capacity of 30-35 million kilowatts will be put into operation. This represents an average of about 7 million kilowatts of new generating capacity put into operation each year, more than double that in the Sixth 5-Year Plan period. In the Seventh 5-Year Plan period, a number of thermal power plants will be built, including pit-mouth power plants in China's major coal-producing areas, harbor power plants in coastal areas, and regional power plants in areas that consume a great deal of electricity but have easy access to coal. In the area of hydroelectric power, emphasis is placed on continued development of the hydroelectric resources of the upper reaches of the Huang He, with the construction of a number of large hydroelectric power stations. A number of medium-sized hydroelectric power stations will be built in places with relatively good hydroelectric resources in northeast and east China and in other regions. At the same time, assistance will be given to the localities to develop small and medium-sized hydroelectric power stations.

At present, construction of state-financed large and medium-sized power stations is progressing rapidly. Many areas and departments are also playing a

part in speeding up power construction by raising funds in a variety of forms. According to statistics, 25 provinces, autonomous regions and municipalities have begun to raise funds; a total of 10.7 billion yuan has been raised; and power stations under construction and those that will be built have a total generating capacity of 10 million kilowatts. Adding a number of power facilities to be built with foreign funds, China's power industry is showing encouraging prospects for growth.

Judging by present conditions, the Yantan hydroelectric power station is expected to check the water flow 1 year ahead of schedule; the Longyangxia hydroelectric power station on the upper reaches of the Huang He will close the sluice gates to store water within this year; the generating units of a large number of power plants including the Jianbi, Douhe, Chongqing, Luohe, Xingtai, Shentou, Zouxian, Yaomeng and other power plants will be put into operation in this year; and the Gezhouba power station will put four turbogenerators into operation.

12802/12859
CSO: 4013/126

POWER NETWORK

NORTH CHINA GRID INTRODUCES BIG THERMAL UNITS

HK020210 Beijing CHINA DAILY in English 2 Jul 86 p 3

[Text] The North China Power Grid is introducing 300-megawatt and even larger thermal generating units, a senior power official said in Beijing on Monday.

It is turning into an ultra-high voltage electricity network consisting of 500kV transmission lines, and will eventually be linked to the Northwest, Northeast, and East China grids to form an integrated nationwide electricity supply network.

Zhang Shaoxian, director of the North China Power Administration, said that its short-term construction plan was to install more large generating units, and to continue to set up 500kV transmission and transforming equipment.

This would turn the North China Grid into a power system with 500kV lines as the trunk circuit loop, and microwaves as the main channels for distribution, communications, and data transmission.

The grid supplies electricity for Hebei and Shanxi provinces, Inner Mongolia Autonomous Region, Beijing, and Tianjin, and has a total generating capacity of more than 11,000 megawatts at present.

Zhang said that to ensure safe and economical operation of the grid and to improve its automation, the administration had imported complete sets of new equipment for distribution, high-voltage power transformation, power cables, microwave protection and audio-frequency load-control equipment.

The North China Grid has imported more than $600 million worth of equipment and technology over the past few years. But demand for power still surpasses the supply.

To overcome the shortfall, new generating units with a capacity of 54,000 megawatts will be built over the next 5 years.

/9716
CSO: 4010/66

POWER NETWORK

HEILONGJIANG TO ADD 2.4 MILLION KW IN 7TH FYP

Harbin HEILONGJIANG RIBAO in Chinese 10 Mar 86 p 1

[Article by Zhang Zhenfu [1728 2182 4395]]

[Text] Heilongjiang will quicken the pace of electric power construction during the period of the Seventh Five-Year Plan [FYP]. According to preliminary estimates, total investment will be three times that of the period of the 6th FYP. The additional 2,425,000 kilowatts of power generating capacity will be more than twice that of the 6th FYP. The 2,000 kilometers of 220 kV superhigh-tension power transmission lines is 1.3 times that of the 6th FYP. Also, the additional transformer capacity of 2.5 million kilovolt amperes will be 1.2 times that of the 6th FYP. There will be 13 power generation construction projects in Heilongjiang during the period of the 7th FYP, with the first phase of the construction at the Harbin No 3 Power Plant, the second phase of the construction at the Fularji No 2 Power Plant, the Harbin power plant improvement project, the Liangzihe and Jiamusi power plant expansion project, the first phase of the construction at the Shuangyashan power plant, the Fularji thermal power plant expansion project, the third phase of the construction at the Mudanjiang No 2 power plant, and the ethylene self-contained power station construction project to be placed into production during the 7th FYP. There are also 17 transmission and transformer construction projects to complement them. Thus, during the period of the 7th FYP, from Fularji in the west to Shuangyashan in the east, there will be 30 electric power construction projects in progress with an anticipated 500,000 kilowatts of power generation capacity being placed into production annually.

Of over 2,400,000 kilowatts of power generation capacity to be added during the 7th FYP, over 86 percent will be large generating units of over 100,000-kilowatt capacity.

During this period, 500 kV ultrahigh-tension power transmission lines will be seen in Heilongjiang for the first time. The 220 kV East Harbin Transformer Station is in the process of construction and installation and is scheduled to go into production this year. It will link the province's eastern and western power networks, ending many years of separate operation, putting into practice centralized control and dispatching, increasing the reliability of the power supply capability of the entire province.

8174/13045
CSO: 4013/111

ACCELERATING JILIN'S ELECTRIC POWER CONSTRUCTION

Changchun JILIN RIBAO in Chinese 7 May 86 p 2

[Article by Gao Yan [7559 0917], director, Jilin Provincial Power Industry Bureau]

[Text] Electric power is the "vanguard" in national economic development. The grand blueprint of the four modernizations depicts a bright future for the development of the power industry and also sets glorious but arduous tasks for it. At present, the problem of power shortage is nationwide. In the northeast region, the problem is most serious in Jilin Province, with a shortfall of more than 16.5 percent. In the early period after the founding of the People's Republic, Jilin ranked first and third in the country in power production and installed generating capacity respectively. Now the province has dropped to 14th place in power production, and its once power surplus has turned into a power shortage. During the Seventh Five-Year Plan period, we should strive for a major buildup of the power industry, complete and put into operation hydroelectric generating units with a total capacity of 945,000 kilowatts, and install eight new thermal units totalling 1.4 million kilowatts, 120,000 kilowatts more than the present capacity of all the thermal generating units in the province put together. In support of the power generating facilities, we should also complete the Dongfeng 500kV extra-high-tension substation, strive to complete the Changchun 500kV extra-high-tension substation and the 500kV extra-high-tension major power transmission line leading from Dongfeng to Changchun and to Harbin, and install 2,000 kilometers of new 220kV transmission lines, so that the province's seven cities and prefectures will all be connected by 220kV transmission lines with the major power grids in the northeast.

To carry out the power development plan for the Seventh Five-Year Plan, the most important thing to do is reform. We must change the old tradition of the electric power monopoly, arouse the enthusiasm of various quarters to build power stations, and promote "simultaneous development" in four areas. First, simultaneous development of big, medium-sized, and small projects. While concentrating on the construction of large generating units and extra-high-tension power grids, attention should be paid to developing small thermal power plants and small hydroelectric power stations where conditions exist, so that both large and small power facilities are developed at the same time. Second, simultaneous development of hydroelectric, thermal

and nuclear power stations. While paying attention to exploiting hydroelectric resources and developing thermal power stations, vigorous efforts should be made to complete preliminary preparations for nuclear power projects during the Seventh Five-Year Plan so that construction of nuclear power stations can be started in the Eighth Five-Year Plan, completed in the Ninth Five-Year Plan and put into operation by the end of the century. Third, simultaneous efforts of the state, collectives and individuals. It is necessary to mobilize all trades and occupations and all the people to build power stations. Power stations can be built by trades, enterprises and the masses with funds raised by themselves. The measures for giving preferential treatment to those building power stations should be implemented and perfected constantly, and the policy of allowing them to make a profit should be upheld to bring into full play the enthusiasm of all concerned. Fourth, simultaneous development of power facilities with domestic funds, foreign funds and funds raised by the masses. It is necessary to arouse the enthusiasm of the localities to build power stations and encourage them to raise funds for power construction in a big way.

This year is the first year of the Seventh Five-Year Plan and a year of crucial importance in developing the power industry in Jilin Province. At present, there are three large and medium-sized power stations and a large 500kV substation under construction simultaneously in the province. Among them, the Changshan thermal power plant expansion project and the Jilin thermal power plant expansion project have been listed by the state as major projects. Efforts should be made to speed up the construction of these projects so that they can be put into operation to give benefits ahead of schedule. Since the beginning of this year, the tradition of "winter inactivity" has been broken, and construction work continued through the winter season. The bureau's leading comrades in charge of capital construction led office cadres to the construction sites of major projects to work and solve construction problems on the spot. An upsurge in power construction is beginning to take shape throughout the province. While paying attention to projects under construction, it is also necessary to pay attention to site selection and feasibility studies of pending projects. Whether they are new construction, expansion, or renovation projects, it is always necessary to conduct research and draw up a number of plans, which will be evaluated scientifically, and the best will be chosen for implementation.

We have a contingent of power construction workers who have a glorious tradition and are particularly good at fulfilling tough assignments. For many years, they have worked in the south and the north and made many contributions, for which they have been lauded by the party, the state, departments and bureaus at higher levels and the local people. However, we should also be able to see that as the power industry develops rapidly, the quality of power workers also urgently needs to be upgraded. First of all, it is necessary to pay attention to the ideological education of the staff members and workers and strengthen ideological and political work to increase their sense of responsibility as masters. Next, it is necessary to strengthen general education and technical training. The construction enterprises should study and popularize new construction techniques and modern management methods, provide training for special types

of construction work and develop in the direction of specialization. The production enterprises should actively contribute to the training of personnel for the newly completed power generating and supply installations to start operation. Third, it is necessary to update the knowledge of engineers, technicians, administrative and management personnel and leading cadres at various levels, who should strive to acquire modern construction and management skills. When all this is done, and if the vast numbers of power workers work hard for the country and fulfill their duties, we assuredly will be able to solve the serious power shortage in Jilin Province and meet the power demands of industry, agriculture and the people at an early date.

12802/12899
CSO: 4013/137

POWER NETWORK

RURAL POWER DEVELOPS QUICKLY IN GUANGXI

HK240727 Nanning Guangxi Regional Service in Mandarin 1000 GMT 22 Jun 86

[Excerpts] New progress has been made in electric power management throughout the region.

Rural electric power in our region has developed relatively quickly. By the end of last year, rural areas throughtout the region had 49,000 km of high-tension and 75,000 km of low-tension transmission lines. All counties and cities, 90 percent of the townships, and 60 percent of the villages have electricity. The amount of electricity used in industrial and agricultural production at and below the county level throughout the region last year was 2.2 billion kilowatt-hours, which accounted for about one-fourth of the total amount of electricity used in the whole region.

With the development of electric power work, the rural electricity supply departments in our region have done really well in grasping the readjustment and improvement of electric cables and have worked hard to reduce waste in electricity consumption.

The rural electricity supply departments in our region have also put safe electricity consumption in first position and constantly carry out activities to ensure accident-free, safe electricity consumption for 100-day periods in the rural areas.

CSO: 4013/140

PROMOTING RURAL SMALL-SCALE THERMAL, HYDROPOWER

Chengdu SICHUAN RIBAO in Chinese 19 Apr 86 p 1

[Article by staff commentator: "Step Up Development of Small Hydroelectric and Thermal Power Stations in Rural Areas"]

[Text] Rural economic development has brought on increasing demands for electric power. Electric power development is closely linked with rural prosperity, and must not be overlooked.

In the Sixth 5-Year Plan period, the installed generating capacity of small rural hydroelectric and thermal power stations in our province increased to a total of 1.15 million kilowatts. However, with the growth of county-run industries and town and township enterprises, plus the need to increase agricultural production and improve the living standards for peasants, rural power consumption has risen sharply, and existing power stations have fallen far short of meeting demand. Therefore, speeding up the development of the power industry in the countryside has become an urgent task in developing the rural economy.

How can this problem be solved? Some people place their hopes on readjustments by the big state-operated power grids, or expect the state to speed up construction of large power stations. It may not be unreasonable to hope so, but large state power stations cannot possibly be built in a short time, nor can the big state power grids provide quick solutions to rural power shortage. At present, only some 40 counties in this province get their power directly from the big power grids, while 137 counties rely on small hydroelectric and thermal power stations for their power needs. This shows that at present and for a considerably long period to come, increasing rural power demands will have to be met by developing small hydro and thermal power stations.

This province is very rich in hydroelectric resources with a total latent capacity of 150 million kilowatts, and 92 million kilowatts can be tapped. Small hydroelectric resources which can be exploited in the rural areas total 51 million kilowatts, but only one-fifth of this capacity has been tapped. The potential is great for further development. The province had an early start in developing small hydroelectric resources and has accumulated a great deal of experience in surveying, designing, construction, and management. We should make use of this advantage and speed up the development of small hydroelectric resources.

At present, except for some state loans and subsidies, we should rely mainly on ourselves to raise funds and make joint efforts to speed up the development of small rural hydro and thermal power stations. The localities, collectives and individuals are all encouraged to take part. Partnerships can be formed between peasant households, between collectives and peasant households, between collectives and localities and between power-using units and power-supply units. Much can be accomplished by many working together. Popularity should also be given to the experience of some counties where experiments have been conducted to set up their own small power grids on a county basis to encourage the various kinds of jointly operated small power stations to link up and sell power together and arouse the masses' enthusiasm to run power stations.

The leadership of all the cities, prefectures and counties should regard developing the rural power industry as a major task of strategic significance. They should follow Chongqing's example in getting things done and promote the continuous development of the rural power industry.

12802/12859
CSO: 4013/126

CANADA GIVEN APPROVAL FOR THREE GORGES STUDY

HK130843 Hong Kong SOUTH CHINA MORNING POST in English 13 Jun 86 Business Post p 2

[Report by Canadian correspondent Richard Liu]

[Text] China has given Canada the green light to conduct a feasibility study on what could be the world's largest hydroelectric project on the [Chang Jiang].

The massive Three Gorges dam project is estimated to cost at least C$15 billion (about HK$85 billion) and will take about 20 years to complete, according to International Trade Minister James Kelleher, who has just returned to Ottawa from Beijing.

The C$7 million study, financed by the Canadian Government, will be carried out in cooperation with the World Bank. The private companies which will undertake it have not yet been selected.

"I think this is just superb news for Canada," Mr Kelleher said. "It will certainly give us a foot in the door in any future development of this project."

China's Minister of Water Resources and Electric Power, Mrs Qian Zhengying, gave the approval during a meeting with Mr Kelleher.

Mrs Qian also said she would be pleased to see Canada take part in a C$600 million hydroelectric project known as Gehe Yan "if Canada offers attractive financing."

A consortium of Canadian companies, Canadian International Project Managers, has been pressing Ottawa to come up with a soft financing package for the Gehe Yan project.

The consortium has been waiting for the Canadian International Development Agency to provide credit concessions to the Chinese so that it can proceed with a bid for the project at China's invitation.

Canadian Prime Minister Brian Mulroney, during his visit to Beijing in May, offered China C$350 million in long-term, interest-free loans in addition to a $2 billion line of credit Canada extended to China in 1980.

Mr Kelleher said this kind of financing "has to be offered today in order to secure large projects of this nature."

China has also invited Canadian companies to bid for several large power station contracts.

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CSO: 4010/58

NEW HYDROELECTRIC DAM PLANNED FOR CHANG JIANG

OW180738 Beijing XINHUA in English 0630 GMT 18 Jun 86

[Text] Beijing, 18 Jun (XINHUA)--A hydroelectric dam with a capacity of 1.2 million kilowatts will be built at Yidu, where the Qing Jiang and the [Chang Jiang] rivers meet, according to today's overseas edition of PEOPLE'S DAILY.

The Geheyan dam on the Qing Jiang will involve a total investment of 1.3 billion yuan. It will be the third largest power project on the Chang Jiang river system following Gezhouba and Wuqiang. The project will be able to generate 3 billion kilowatt-hours of electricity a year and store 3.4 billion cubic meters [of water].

The paper said, "It will play an important role in easing the power strains in central China and reducing the threat of flood. The navigation conditions on the Qing Jiang will also be improved. Annual cargo shipments are expected to increase from 700,000 tons to 2.6 million tons."

Construction preparations will start in October and the water will be diverted for the dam construction in October 1988.

The first of four generating units is expected to go on line in 1993 and the other three will be completed 2 years later.

The dam will be 674 meters long and 151 meters high.

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CSO: 4010/65

GEZHOUBA NO. 2 POWER STATION BEGINS OPERATION

OW091351 Beijing XINHUA in English 1334 GMT 9 Jun 86

[Text] Wuhan, 9 Jun (XINHUA)--The first generating unit of the second hydroelectric power station of the Gezhouba dam project in central China went on line today.

With a designed capacity of 125,000 kW, the unit is supplying electricity for Hubei, Hunan, Henan, and Jiangxi provinces to ease the acute electricity shortage there, said a project official.

Another three units, all with the same capacity, will go into operation toward the end of this year. In 1987, another five units will be put on line. And the rest of the 14 units will go into operation in 1988, he said.

This is the second stage, totalling 1.75 million kW, of the Gezhouba dam project which will, when completed, have a generating capacity of 2,715,000 kW.

The first stage, completed in 1981, had a capacity of 965,000 kW. A total of 26.7 billion kWh of electricity has been generated.

The Gezhouba dam project, with a total investment of 4,848 million yuan, China's biggest multi-purpose water conservancy project, lies at the outlet of the Xiling Gorge, one of the three scenic gorges along the [Chang Jiang].

The completion of the project will help ease the power shortage in the country, a shortage estimated to be 40 billion kWh annually.

/12624
CSO: 4010/56

HUNAN DEVELOPS SMALL-SCALE HYDROPOWER POTENTIAL

Beijing ZHONGGUO SHUILI [CHINA WATER CONSERVANCY] in Chinese No 3, 15 May 86 p 34

[Article by Shi Jie [0760 2638], member, Standing Committee, Hunan Provincial Advisory Commission (compiled and edited from speeches given at Department of Water Conservancy and Hydropower, Hunan Provincial Government)]

[Excerpts] Small-scale hydropower has a great potential in Hunan, and constitutes an important component of its energy resources. Practical experience in the last few years indicates that the development in small-scale hydropower has produced enormous social benefits and economic results. It can promote the development of township and village enterprises and local industry, boosting the economy of townships and counties. It can transform agricultural production and improve the living standard of the people. One should, therefore, take full advantage of rich water resources to actively develop small-scale hydropower and to accelerate the progress of rural electrification to provide the energy for the revitalization of Hunan's economy.

Today, attention should be directed to the following two problems in Hunan's small-scale hydropower construction:

1. The problem of understanding small-scale hydropower construction. Although more and more people have come to appreciate the importance of small-scale hydropower, there are still some people, particularly in leadership positions, who are prejudiced against the development of small-scale hydropower. They are of the opinion that there is too much hydropower and too little thermal power in Hunan, resulting in the so-called "imbalance between hydro and thermal power." The more small hydropower projects, they maintain, the greater the conflict between prosperity and drought. Such perception is not realistic. In the early stage of small-scale hydropower construction some oversights indeed occurred. Many stations were built on main river channels with great swings between abundance and drought. This was due to our lack of experience. We placed too much emphasis on installed capacity and too little attention to the balance between abundance and drought. In the last few years, however, this problem has attracted wide attention, and efforts have been made to resolve the problem through readjustment within the small hydropower system itself. The situation has greatly improved. Realistically, as Hunan must rely on

hydropower, it must develop small-scale hydropower to the maximum extent possible. Today the ratio of hydropower to thermal power in the provincial power grid is about 1:1. However, most of the thermal power loses money and needs subsidies from hydropower. Generally speaking, thermal power in the power grid cost about 7 to 8 cents per kilowatt-hour whereas hydropower costs only 4 to 5 tenths of a cent, a more than 10-fold difference. The situation in the villages is quite similar. The cost of small-scale thermal power amounts to over 10 cents per kilowatt hour, while small-scale hydropower costs only about 1 cent, also a difference of more than 10-fold. Practical experience shows that whatever county wants to initiate a thermal power project should use small-scale hydropower as its basis. Without the support of backbone small-scale hydropower, it would be difficult for small-scale thermal power to succeed. Even if small-scale thermal power can be installed it would be unable to bear the heavy burden.

2. Problems relating to the construction management of small-scale hydropower. Three problems must be resolved: (1) We must carefully learn from experience. A review of the history of the development of small-scale hydropower shows that in Hunan it has developed very rapidly since the 1970's. The development, particularly rapid in the last few years, has laid an excellent foundation for the entire province. However, one must also be aware of the shortcomings in small-scale hydropower. The most glaring problem is that the annual hourly utilization rate is very low, amounting only to over 2,000 hours. The power distribution is inadequate, resulting in considerable losses which sometimes reach 20 to 30 percent. The quality of management is rather poor, and the number of non-production workers very high. Consequently, production cost is high and efficiency is low. The unit production cost for many power stations reached 2 cents per kilowatt-hour. These problems are undoubtedly damaging to the reputation of small-scale hydropower. It is very important that we should manage these existing stations properly. We can no longer place emphasis only on installed capacity in the small-scale hydropower development with no regard to economic results. (2) We should formulate a correct guiding ideology to steadfastly develop small-scale hydropower. It is necessary to strengthen technical leadership and improve planning and construction. Small-scale hydropower should have its own source of supply where it can have unified control of generation, supply, and consumption. In the past, small-scale hydropower performed rather well in Tongdao County, but now many stations went bankrupt. Why? On one hand, there were people to use the electricity but none to pay for it. When the bills could not be collected, the staff could not be paid. There was nobody to look after the station. In other cases, the quality of construction was poor and maintenance was ignored. The station collapsed as soon as a flood occurred. One can learn a lesson from all this: Counties with mountainous regions should be studied individually and plans for solving local power problems should be formulated. Construction should proceed in an orderly and planned fashion. We must stress results instead of the statistics of installed capacity. We should never start a half-baked project. Furthermore, we must insist on a policy of self-sufficiency. Investment with loans carries a rather high interest. Without the persistent and hard struggle for self-sufficiency on the part of the units and masses, the project cannot

succeed. For this reason hydropower construction in the next stage should not have as many projects as in the past. It is necessary to gauge our capability against the size of a project and make our decision in a measured manner. We should shorten the battle lines as much as possible. Once started, we must concentrate resources to complete the construction in 2 or 3 years, or even in a shorter span of time. The key to speedy completion of a project is the interest of the leadership. The Ganxijiao power station with its 7,500-kilowatt capacity is one of the backbone stations in Luxi County. It only took a year to build the station, beginning from site selection to ground breaking to final completion. Their major experience includes: 1) the County Party Committee exercised direct supervision of the project. The Party Secretary went to the construction site once every 2 or 3 days to help resolve problems that might arise; 2) The designers and engineers lived on the construction site to make necessary on-site modification and revision of designs; 3) The contractor for the construction was determined by bids and the terms of the contract were strictly adhered to; and 4) There was a special material support group to guarantee an uninterrupted flow of materials. Such experience is worthy of learning by other regions. It should be emphasized once more that under the current budget constraints we should not hope for more new items of construction in various regions. One should devote his major resources to power distribution, and restructuring and developing the potential of the existing power stations.

3. A sound relationship between the small-scale hydropower and the larger power grid should be established as small-scale hydropower and the grid are interdependent. The development of small-scale hydropower relieves pressure on the power grid and provides some surplus to it. On the other hand, it is difficult for the small-scale hydropower to operate independently of the large power grid. The best arrangement is for the small hydropower and the large power grid to collaborate with each other and to support each other. Today, several counties such as Xianghengdong, Pingjiang, and Cili have made good progress in this respect. After the small-scale hydropower was linked to the grid, surplus power could be fed into the grid and, in time of need, power could be drawn from the grid, benefitting both sides. In the long term, two goals should be established in small-scale hydropower construction. One is to establish small-scale hydropower as an economic entity with the county as its basic unit, particularly in counties where small-scale hydropower has a strong base. The other is to institute a unified control of generation supply and consumption so that beneficial economic results can be fully achieved. In formulating the program for generation, supply, and consumption of electricity at the county level, it is important to pay attention to the study of measures to resolve conflicts between abundance and drought and to improve the quality of electric power supply.

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CSO: 4013/124

SCRAMBLE ON TO CASH IN ON THERMAL POWER CONSTRUCTION

HK200213 Hong Kong AFP in English 0133 GMT 20 Jun 86

[Article by Lawrence MacDonald]

[Text] Beijing, 20 June (AFP)--China has put expensive hydro and nuclear energy projects on the back burner in favour of a network of coal-burning plants that a new state-run firm is quietly importing with unprecedented speed, Chinese and Western energy experts here said.

Competition for contracts--likely to be worth nearly 3 billion dollars within the next 5 years--has been fierce, with China playing would-be sellers against one another in complex package deals, the experts said.

Huaneng International Power Development Company, the Chinese agency purchasing the plants, has a mandate to bypass China's bureaucracy and deal directly with foreign firms with an alacrity rarely seen in Chinese state organizations, analysts said.

"The negotiations took only 9 months from start to finish. Old timers said it couldn't be done,"an industry insider recalled of Huaneng's first contract.

That contract, a 365-million dollar deal for two pairs of coal-fired thermal plants, was signed with a consortium led by General Electric (G.E.) of the United States in February. It was financed by a consortium of foreign lenders headed by a U.S. investment bank.

Huaneng (Chinapower) officials said the deal was the first step in a three-phase plan to install coal-burning plants throughout China in the next 5 years.

Cost estimates provided by Huaneng and Western energy experts for individual projects indicated the three phases together would be worth close to 3 billion dollars.

The individual contracts of several hundred million dollars are small compared to other projects.

An estimated 2 billion dollars is being spent on the Daya Bay nuclear plant planned near Hong Kong and foreign experts believe a controversial hydro-electric scheme on the Huang He could cost a staggering 20 billion dollars.

But China's lack of hard currency and environmental worries about the "Three Gorges" dam proposed for the Huang He have slowed progress on both projects.

Though French officials hope a contract on Daya Bay will be signed this October after 8 years of talks, negotiations on other nuclear plants have been postponed.

There have also been signs recently that foreign participation in the Three Gorges project will be less than the bonanza foreign firms had sought.

Deputy Premier Li Peng, a Soviet-trained electrical engineer who has emerged as China's energy Czar, said during a visit to West Germany last week that China would not contract out work on Three Gorges to foreigners but would construct the dam itself.

Earlier this year, Mr Li said China would rely mostly on its own efforts to develop nuclear energy, a reversal of earlier official indications that China would import a large number of foreign plants.

"China's signals have been very clear. Despite very serious energy shortages, the Three Gorges is way down the road and they don't have the money for nuclear," a foreign expert said. "With the sudden drop in oil prices, coal is the only energy field where we're seeing any real action."

Under its contract with Huaneng, G.E. is to build a pair of plants in Hebei Province, near Beijing, and another in the port city of Nantong, near Shanghai. When completed in 1988, each pair will provide 700 megawatts of power for nearby factories, some of which run only a few days a week for lack of power.

Huaneng has since signed a similar-sized contract with Japan's Mitsubishi Heavy Industires for two or more pairs of plants, in the northeastern port city of Dalian and in coastal Fujian Province.

Huaneng General Manager Yu Mingji said tenders for a second four-pair phase with plants in major industrial areas of China are to be invited in stages in the months ahead, while a third phase was currently being planned.

Key to Huaneng's success is a combination of foreign financing, government permission to charge more than state-set rates for power produced, and counter-purchases, a form of barter in which foreign sellers agree to buy Chinese goods with all or part of their proceeds.

In a typical deal, Huaneng contracts with a foreign seller for a plant and turns it over to a local power authority, which sells the electricity to power-starved factories at rates higher than those normally allowed.

The locality is expected to repay Huaneng in domestic currency, which it converts, through various methods including counter-purchases, into hard currency to pay off foreign loans.

Counter-purchases of coal, oil and cotton goods reportedly accounted for 30 percent of G.E.'s contract.

France's Alsthom Atlantique was said by industry sources to have agreed to make counter-purchases of 100 percent in a recent Huaneng deal for a gas turbine plant in Shantou, a special economic zone on the South China coast.

Huaneng's tough, fast-moving negotiators appear to have earned the respect of their foreign counterparts, who complain about tact even as they brag that their deals went ahead with lightening speed.

"They squeeze you on the price, then they squeeze you on the financing, then they squeeze you on the counter-purchases," said one foreign negotiator who was nonetheless busily preparing for Huaneng's next round of tenders.

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CSO: 4010/62

HUANENG INTERNATIONAL STEPS UP NEW PLANT CONSTRUCTION

HK210430 Beijing CHINA DAILY in English 21 Jun 86 p 2

[Report by staff reporter Zhao Xinming]

[Text] In an attempt to ease the country's power shortage, the Sino-Hong Kong joint venture Huaneng International Power Development Corporation has stepped up its efforts to build power plants using both domestic and foreign funds.

During the Seventh Five-Year Plan (1986-90), the corporation plans to import generating equipment with a combined capacity of 6.2 million kilowatts, of which 5.25 million kilowatts will go into operation by 1990, Mao Henian, chairman, told the second meeting of the corporation's board of directors in Beijing yesterday.

This year, the corporation intends to import four power plants with a total generating capacity of 3.3 million kilowatts. Preparatory work is in full swing, the chairman said.

The four plants will be in the cities of Dezhou, Shanghai, Yueyang, and Chongqing. The corporation is now negotiating with foreign firms to import equipment for the power plant in Dezhou, Mao said.

Requests for suggestions and proposals for the power plants in Shanghai and Yueyang have been worked out and will be sent to foreign firms, he added.

As the power plant in Chongqing will burn coal, methods for cutting sulphur emissions should be sought first, Mao said. The corporation has recently exchanged views on the subject with firms from the United States, France, Japan, and West Germany.

It is expected that contracts for buying equipment for the four plants will be concluded by the end of this year if the conditions are satisfactory, he said.

Over the past year, the corporation has signed contracts with the General Electric Consortium of the United States, the Mitsubishi Corporation of Japan and the Alsthon Corporation of France to provide equipment for five other power plants.

The five plants, with a combined capacity of 2.9 million kilowatts, are situated in the cities of Dalian, Fuzhou, Nantong, Shijiazhuang, and Shantou and will be operational by the end of 1988.

Construction of the infrastructure facilities for the five plants have been completed and work on the plant buildings will start in August, Mao said.

Established in June 1985, Huaneng is a joint venture of five partners from the mainland and Hong Kong.

Over the past year, the corporation has concentrated on new ways of speeding the development of the power generating industry as well as the promotion of foreign trade.

When buying equipment from abroad, the corporation combines commercial business, technology imports, and loans with other trade.

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CSO: 4010/65

THERMAL POWER

POWER MINISTRY DECIDES TO BUILD 1000 MW PLANT IN DUKOU

Chengdu SICHUAN RIBAO in Chinese 18 May 86 p 1

[Summary] In order to satisfy the demand for electricity by the second stage project of Pan Gang and to promote economic growth in Panxi, the Ministry of Water Resources and Electric Power has decided--before the completion of the Ertan hydroelectric power station is completed--to build the big 504 thermal power plant at Mashangping in Dukou City; the plant will have an installed capacity of about 1 million kilowatts.

At present, Dukou and Xichang constitute an independent electric power grid, basically capable of satisfying the electric power demand of their immediate area. But in the second half of the year [1986], when this network is absorbed by the main regional network, there will be unified regulation and a power shortage will ensure. Dukou faces a coal-rich region of Yunnan Province and the power plant would be near Yunnan's Huaping coal mines.

In order to realize the exploitation of coal resources, the Ministry of Water Resources and Electric Power and the Sichuan Provincial Government are pushing to have the Ertan hydropower station included as an item in the Seventh Five-Year Plan and have decided to build a large-scale thermal power plant at Mashangping in Dukou City. The Southwest Electric Power Design Institute is handling the planning; initial feasibility studies have been made and approved. The first stage of the project calls for the installation of two 100 MW generators to be followed by the installation of four 200MW generators in the second stage.

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CSO: 4013/136

BRIEFS

QINGZHEN EXPANSION BEGUN--Work on the expansion of the Qingzhen power plant--the largest electric power construction project in Guizhou Province--began on 30 May. The expansion project calls for the addition of two single-unit 200MW thermal generators to give the plant a total installed capacity of 600MW. [Text] [Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 31 May 86 p 1] /6091

CSO: 4013/134

TASKS, OBJECTIVES OF COAL INDUSTRY IN 7TH FYP SUMMARIZED

Beijing ZHONGGUO MEITAN BAO in Chinese 8 Mar 86 p 3

[Article by Mei Yan [2734 1484]: "Tasks and Objectives of the Coal Industry During the Seventh 5-Year Plan"]

[Text] The major tasks of the coal industry during the Seventh 5-Year Plan period can be summarized in three sentences. The first is to persist in carrying out the reform, continue to implement and improve the policy of requiring the unified distribution coal mines to take overall responsibility for their input and output, boldly explore and strive to lay the foundation of the economic system of a coal industry with Chinese characteristics and full of vigor and vitality. The second is to strengthen ideological and political work and build up the ranks of staff members and workers who are dedicated to the coal industry and who have lofty ideals, moral integrity, culture and a sense of discipline. The third is to rely on science and technology, vigorously push forward the coal industry's modernization, and fulfill all the tasks for which the coal industry is responsible. In short, it is to give top priority to reform and pay attention to building the "two civilizations" at the same time.

At the party's national conference, Premier Zhao Ziyang said: "The Seventh 5-Year Plan should be a program for building a socialist material and spiritual civilization simultaneously." For the coal industry, this means the proper application of "two driving forces," one material and one spiritual, to achieve "two results"--to create material wealth, produce material results and fulfill coal production and construction tasks in the Seventh 5-Year Plan period on the one hand, and to create spiritual wealth, produce spiritual results and train a contingent of staff members and workers with lofty ideals, moral integrity, culture and a sense of discipline on the other hand.

Therefore, when we talk about fulfilling the tasks in the Seventh 5-Year Plan, we should not think only about coal production and construction to the neglect of the building of the spiritual civilization. Judging by the actual conditions of the coal industry, our task in building the spiritual civilization is still very arduous. First of all, we must strengthen the leading bodies at all levels, make our cadre ranks more revolutionary, younger, better educated and professionally more competent and really improve our leadership style; adhere to the four cardinal principles and resist and combat bourgeois ideas of liberalization; and train and temper our people with the five spirits of model workers to bring up a mighty force of industrial workers with lofty ideals, strict discipline, a hard-working style and militant spirit.

The goals for coal production and construction in the Seventh 5-Year Plan are: In 1990, the country's total coal output is expected to reach 1 billion tons, pre-miner coal output of unified distribution coal mines to top 1 ton per day, and mechanized mining, tunneling, and transportation to reach 56 percent; efforts should be made to complete the capital construction tasks assigned to the coal industry for the Seventh 5-Year Plan period so that enough momentum will be built up for the continued growth in coal production in the 1990's; safety conditions should be improved steadily so that the occurrence of major and serious accidents can be basically brought under control; and a good job should be done in protecting the environment and improving the living standard for staff and workers.

To successfully accomplish the tasks and goals of the Seventh 5-Year Plan, the following guiding principles and working policies must be followed. First, while continuing to implement and improve the various reform policies focused on the unified distribution coal mines assuming full responsibility for input and output, bold and positive efforts must be made to explore and open up a way to lay the foundation for the economic system of a new coal industry with Chinese characteristics and full of vigor and vitality in the next 5 years. Second, a rational principle on the geographic distribution and policy on the development of the coal industry should be decided on, which should give top priority to the technological transformation, renovation and expansion of existing coal mines, properly arrange the construction of a number of small and medium-sized coal mines and give active support to the sound development of local coal mines. Third, it is necessary to rely firmly on scientific and technological progress and vigorously push forward the coal industry's modernization. Fourth, special emphasis should be placed on coal mine safety, and the principle is to pay equal attention to improving safety techniques and equipment and raising the standard of safety management. Fifth, with emphasis on improving economic performance, it is necessary to pay attention to basic work, strengthen management and administration and "change the path and pattern" of enterprises. Sixth, it is necessary to adhere to the open-door policy, expand exports to earn more foreign exchange, actively use foreign capital to expand key construction projects and do a good job in importing technology and bringing in qualified people. Seventh, we must adhere to the principle of building the "two civilizations" simultaneously, strengthen work at the grassroots level, build up the ranks of workers and staff members, and unite and lead the mighty coal industry army 5 million strong to make contributions and unfold great plans for the coal industry's modernization.

12802/12859
CSO: 4013/129

ON PROMOTING MODERNIZATION OF COAL INDUSTRY

Beijing ZHONGGUO MEITAN BAO in Chinese 12 Mar 86 p 3

[Text] In the past 30 years and more, China's coal industry has come a long way in upgrading its scientific and technological standard and improving the quality of staff and workers. China's coal mines are in the process of moving from crude equipment toward a higher level of production technology suited to China's conditions. In the present stage, the timely call for the development of modern coal mines step by step and with specific emphases is entirely in keeping with the objective laws governing the coal industry's development in China and strongly reflects and represents the desire and demand of the masses of staff members and workers of the coal industry system to fight for it.

The modernization of the coal industry is a long-term of overall importance, and the Seventh 5-Year Plan period is crucial to the accomplishment of this strategic task. According to the actual conditions of the coal industry and the country as a whole, it is impossible to modernize all the coal mines at the same time. For a considerably long time to come, the technological make-up of the coal industry will remain a multileveled structure, in which modern, mechanized, semimechanized and manual operations exist simultaneously. Therefore, modern coal mines have to be built selectively and step by step.

During the Sixth 5-Year Plan period, we concentrated on the development of 15 modern coal mines. In the Seventh 5-Year Plan period, we will expand more coal mines and try to bring one-third of the unified distribution coal mines up to modern standards. It is estimated that after continued efforts through the eighth and ninth 5-year plans, most of China's major coal mines will rank among the world's advanced, modern coal mines by the end of this century or early in the next century. The Ministry of Coal Industry's leading party group calls on ministry organizations and provincial departments (bureaus) and mining bureaus to make careful arrangements and provide meticulous guidance so that work will move forward toward this end in a realistic manner. First of all, it is necessary to have a clear guiding principle. In building modern coal mines, we must insist on building the "two civilizations" simultaneously. Not only must our production technology be advanced, but our staff members and workers must be good in their political quality, have lofty ideals, observe discipline and regard it an honor to devote themselves to the coal industry. Comrade Yu Hongen vividly summarized the characteristics of a modern coal mine as: "Greater safety, fewer workers, higher efficiency, better results, healthier work style and better living conditions." "A sense of safety in the coal pit,

a sense of well-being at home and a sense of honor being a coal miner"--this is an epitome of the intension of the "two civilizations."

To build modern coal mines, it is necessary to have a scientific standard for equipment, degree of mechanization, economic and technical indexes, production safety requirements, development of the spiritual civilization and welfare facilities. On the one hand, this standard represents a coal mine's level of modernization--and we must not equate mere mechanization with modernization; on the other hand, it is necessary to set different standards for different types and conditions of coal mines, and we must not try to make all coal mines to fall into one pattern. The Ministry of Coal Industry calls on the localities to draw up plans and measures for building the first group of modern coal mines on the basis of local coal-seam and mining conditions and proceeding from realities. In implementing these plans during the Seventh 5-Year Plan period, efforts should be made to build as many modern coal mines as possible, but no attempt should be made to increase the number by lowering the standard.

It is worth mentioning that to build modern coal mines, we must adhere to the principle of "relying on our own efforts, tapping internal potentials, adopting a flexible policy and providing positive support." In the past few years, we have spent money to equip some coal mines, as it was necessary for them to serve as models and play a guiding role. In future, we cannot count on higher government organizations to spend more money to equip a modern coal mine. We must rely mainly on our own power to achieve the goal.

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CSO: 4013/129

QUOTA POLICY SEEN TO AID CONSOLIDATION, STABILIZE PRODUCTION

Yinchuan SHANXI RIBAO in Chinese 4 Mar 86 p 1

[Report by Wei Xuguang [7614 2485 0342] and Gong Gui [7895 6311]: "Base Production Quotas on Consumption Levels, Consolidate and Upgrade Existing Mines, Process and Transform Raw Coal, Stabilize Production and Increase Profits; Provincial Economic Work Conference Sets Forth Shanxi's Coal Production Policy"]

[Text] The currently convened provincial economic work conference sets forth that the development of Shanxi's coal industry must adhere to the policy to "base production quotas on consumption levels, consolidate and upgrade existing mines, process and transform raw coal, stabilize production and increase profits," and that plans for production, shipping, marketing and stocking must be made part of the same account when implementing this year's coal production plan handed down to Shanxi by the state.

In this year's coal production plan, the plan for state-owned mines was directly handed down to coal mines jointly by provincial coal departments and provincial coal shipping and marketing corporations while the plan for rural and township coal mines was directly handed down to county coal management departments. All banking, goods and material, shipping and marketing departments follow this plan to organize funds, goods and materials and shipping. For those which overproduce and cause new overstocking, banks will not give them loans and goods and material departments will not supply them with goods and materials and shipping and marketing departments will not arrange shipping and marketing for them. Management of the shipping, marketing and prices of coal in Shanxi must be unified. Railway transportation must be centrally organized by coal shipping and marketing corporations at all levels and targets must be extended to the mines; rational protective prices for shipping to other parts of the country must be formulated for highway transport. Beginning from this year, local coal mines will be consolidated by stages and in groups. Production of all private coal mines will first be halted and then they will be individually examined by departments in charge judging by their resource, technical, management and safety conditions. Those that meet the required conditions will go through make-up procedures; and those that do not will be firmly shut down. Pits which have been approved but have not realized the "four removals" will be required to consolidate within a given time period and may arrange for production, shipping and marketing only after they meet

the standards. Within 2 to 3 years we should strive to have all rural and township mines throughout the province complete with the "three licences" (resource license, coal exploitation license and business license), meet the "ten-point" safety conditions and become small coal mines with a definite production scale and good economic results. We must shift investment on coal to the depth of processing. During the period of the Seventh Five-Year Plan, investment on coal should be shifted from the past practice of constructing new pits to tapping the potential of existing pits, the screening, washing and coking of raw coal, and collective coal shipping stations. With the exception of pits whose construction has already been started, new ones generally should not be built during the period of the Seventh Five-Year Plan and investment of funds should be used to promote the development of the depth of coal processing.

Persons in charge of the liaison group of the Beijing and Zhengzhou railway bureaus and various railway sub-bureaus are attending the conference.

9586/12899
CSO: 4013/120

POLICY BASING PRODUCTION QUOTAS ON CONSUMPTION LEVELS VIEWED

Yinchuan SHANXI RIBAO in Chinese 4 Mar 86 p 1

[Commentary: "Policy To Base Production Quotas on Consumption Levels of Coal Must Be Implemented"]

[Text] The coal industry plays a decisive role in Shanxi's national economy. Since the Third Plenary Session of the 11th Party Central Committee, the production situation of the provincial coal industry has been good and there have been large increases in coal output year after year. Output of raw coal reached 214 million tons in 1985, representing a 14.5 percent increase over the previous year and an increase of 90 million tons over 1980. During the period of the Sixth Five-Year Plan the average annual increase is 18 million tons and the proportion of coal output in the national total increased from 19.5 percent in 1980 to 25.5 percent. The volume of raw coal transferred to other places has also increased from 70 million tons to 138 million tons, almost doubling it and makes up 75 percent of the national net volume of commodity coal transferred. The development of Shanxi's coal industry has made enormous contribution to easing the national shortage of energy supply and safeguarding smooth implementation of the state's modernization program, bringing real benefits to Shanxi at the same time. Such is the basic situation of Shanxi's coal industry.

The present problem is that because the development of coal production has far exceeded the growth rate of cpaacity in communications and transportation, overstocking of coal in the province is becoming serious day by day. The production plan in 1985 was 183,250,000 tons but actually it was overfulfilled by 28,710,000 tons. Stocked coal amounted to 43,300,000 tons, an increase of 8,500,000 tons over the previous year. Not only was there a loss of 3,600,000 tons due to flushing, spontaneous combustion and weathering, but it also took up 520,000,000 yuan in circulating fund and consumed 85,000 cubic meters of timber as well as 7,700 tons of steel products. Owing to the large increases of coal output year after year, the pressure on communications and transportation has become greater and greater. Freight volume of coal in the province makes up 90 percent of the total volume of rail freight, which has a very strong impact on the coordinated development of the provincial economy. Particularly on New Year's Day or other festivals, the allocation and shipping of the means of subsistence to satisfy the people's needs become important matters to keep busy and rushing every day. Excessive overstocking of coal has caused

internal price reduction and sales competition, and each year economic results are worse than the previous year. As calculated by comprehensive economic departments, the average economic benefit from each ton of coal in the province was 6 yuan in 1980, 3 yuan in 1983, and 1.50 yuan in 1985. According to the survey of the first half of 1985, coal output increased by 14.8 percent over the same period last year while profits dropped by 14.81 percent from the same period last year. Economic results have declined year after year so that the quality of coal mining enterprises has not been improved and accidents are numerous.

The problem described above is a minor aspect of the development of Shanxi's coal production, nevertheless it must be properly resolved. The solution is to earnestly implement the policy of basing production quotas on consumption levels. In other words, on one hand we should do a good job in building Shanxi's heavy and chemical industrial energy base in accordance with state requirements, stress this strategic center, unify planning and make rational arrangement, step up technological transformation, and form a production capability of 400 million tons by the year 2000. On the other hand, we must arrange production according to the state of transportation capacity and market needs, practice overall coordination of production and marketing and of production and transportation. Coal is China's primary source of energy. Along with the progress of the modernization program, the needs of the state on coal will grow continuously. As a key heavy and chemical industrial energy base of the state, Shanxi has the responsiblity and duty to produce commodity coal that can be allocated, are usable and are of high-quality. Therefore, speeding up the construction of the heavy and chemical industrial energy base has always been our unswerving goal. However, the development of coal production must be coordinated with the development of the entire national economy of Shanxi, and it must be particularly suited to conditions of communications and transportation, striving for overall coordination among production, shipping and marketing so that products may be transformed into commodities and reflect real economic results.

The key to coordinated production, shipping and marketing is to set production tasks to a moderate degree. After Shanxi proceeded from reality and handed down its coal production plan, coal shipping and marketing corporations at all levels should organize shipping and marketing according to this plan; goods and material departments supply materials according to this plan; banks and credit departments supply circulating funds according to this plan. Those which undertake production without a plan or overfulfill the plan will not be supplied with raw materials, given loan of circulating fund or assigned shipping and marketing targets. Production, supply and marketing are made part of the same account. Shipping and marketing targets, raw material targets and the degree of fund control should be synchronously implemented at the county level along with the production plan, and counties in turn centrally implement them among enterprises. For highway shipping and marketing, shipping corporations should centralize freight coupons, prices, designated sources of goods, and sales. At exit points on highways for coal shipped outside Shanxi, local county coal shipping and marketing corporations and

communications supervisory and management departments as well as price departments can establish joint highway inspection posts, headed mainly by county coal shipping and marketing corporations to manage the sale of coal and coking coal outside Shanxi and to allocate sources of goods, inspect freight coupons, freight volumes and prices. We must use the "Regulations (trial) for the management of coal exploitation in Shanxi" and the provincial people's government's "Circular on strengthening production safety in rural and township coal mines" as standards to reorganize the safety in local coal mines throughout the province, with emphasis on rural and township mines. All unapproved private coal mines should undergo consolidation and examination. Mines privately and indiscriminiately opened after consolidation should be severely investigated by industrial and commercial departments and handled according to regulations in concern. We must strive to have all rural and township coal mines complete with the "three licenses," distributed in an overall rational way and at a basically moderate scale, forming a group of small and medium-sized coal mines that have both the stamina for development and economic results, and enabling the provincial coal industry to take the path of stable production and increased profits, safety and strength.

In order to correctly implement the policy of basing production quotas on consumption levels, it is necessary to do a good job in handling the three relationships, that is, the relationship between limiting production and increasing sales, the relationship between unifying marketing and increasing profits, and the relationship between provincial departments and prefectural and county finances. It should be said that we ought to impose more limit on coal production where more coal is stocked and less limit where less coal is stocked, and we must not impose arbitrary uniformity. The result will be a reduction in the stocking of coal, the use of circulating fund and the consumption of raw materials, which can only benefit the local economy. Some comrades worry that unified management of shipping and marketing may result in a drop in income for the coal mines and peasants. In reality, the income of those who excavate mines privately and indiscriminately may be affected due to shut down and consolidation, but in terms of the situation as a whole unified marketing can only result in the increase and not decrease of income. Some comrades worry whether rights and money will be taken away with central management of the sale of coal by shipping and marketing corporations at various levels. Here it must be made clear that as far as the provincial shipping and marketing corporations are concerned, unified management of shipping and marketing is merely unified planning and pricing, which can only mean providing service to everyone, and which takes away neither rights nor money. County shipping and marketing corporations are business entities and their income is part of county finances. Of course, there also exists the question of returning benefits to county coal mines, and all counties should do a good job in handling this question, succeed in having most of the benefits going back to the coal mines, retain a portion of it for developing processing and transformation as well as building dispatch and transport stations. However, this must be moderate and not overcentralized, otherwise the coal mines and peasants will lose enthusiasm. Only if the provincial, prefectural and county levels unify ideology, unify understanding, intensify management, and wholeheartedly serve the peasants and grassroots enterprises, it will quickly improve the quality of coal mining enterprises throughout the province, quickly bring wealth to the peasants, and truly build a heavy and chemical industrial energy base from which the people of Shanxi can obtain real benefits.

9586/12899
CSO: 4013/120

STATE MINES EXCEED QUOTA, SMALL MINES EXPERIENCE SLUMP

HK050620 Beijing CHINA DAILY in English 5 Jul 86 p 1

[Report by Staff Reporter Xu Yuanchao]

[Text] The output of state-owned coal mines exceeded the planned production target by 8 million tons in the first 6 months of this year, but small local mines saw a 6 percent drop in production.

The state-owned mines produced 211 million tons of coal, a 1.9 percent increase over the same period last year, representing 51 percent of the state mines' planned target for the whole year, according to the Ministry of Coal Industry.

China's 6-month coal output was 403 million tons, up 0.26 percent over the same period last year, and accounting for 48 percent of the 1986 plan, a ministry official told CHINA DAILY yesterday.

But the local mines had not fulfilled their target, producing 6 percent less than planned, the official said.

The local mines turned out 190 million tons of coal, a shortfall of at least 13 million tons. Production dropped 1.5 percent compared with the corresponding period last year, according to the official.

Of the local mines, the province-owned mines saw a 2.4 percent drop in production over the same period last year, while small coal mines run by townships and individuals reduced output by 10 percent, the officials added.

He attributed the reduction in local mines to poor transportation and a saturated domestic market.

The official said: "This has made some small local mines cut production and in some cases even shut down."

He estimated that production in local mines would probably go up in the second half of the year. Although coal shortages had generally eased, the supply was still tight in power-starved eastern China.

He called on power plants and other coal consumers to work out long-term plans and store as much coal as possible for the fourth quarter of the year--usually the peak season for coal consumption. Otherwise, railway departments may not be able to meet the growing demand for coal at the time.

Earlier, Deputy Coal Minister Hu Fuguo said the outlook for coal supply in the first 6 months was "optimistic." Sichuan, a coal-starved province in southwest China which used to ask for help from other coal producers, has begun to ship and sell coal to other provinces along the [Chang Jiang].

Hu said the coal industry was being put on the "right track." Many coal mines have extricated themselves from their previous predicament in which they devoted their whole energy to high output all year long. Now mines have more chances to concentrate on upgrading and improving quality and management.

In order to increase production efficiency, the ministry has planned this year to reduce production and management personnel by 100,000 at state-owned mines. In the first half of the year, about 80,000 staff had been reassigned to service trades in mining areas, according to the ministry.

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CSO: 4010/66

OVER $2 BILLION IN FOREIGN EXCHANGE USED IN 5 YEARS

Beijing GUOJI SHANGBAO in Chinese 5 Jun 86 p 1

[Article by staff reporter]

[Text] This reporter has learned from the Ministry of Coal Industry that in the past 5 years or so, China's coal industry has used $2.155 billion of foreign capital to develop 13 large coal mines and opencut coal mines with a total annual production capacity of more that 45 million tons.

Most of these large coal mines and opencut coal mines are in Shanxi. Among them, the Pingshuo Antaibao opencut coal mine is a joint venture with the Occidental Petroleum Corporation of the United States. It has a designed capacity of 15 million tons. Construction began officially in July 1985, and production is expected to begin in July 1987. Construction of the Changcun coal mine in Luan, Shanxi, will be completed in 1989. It is being built with a loan from the World Bank, and will have a production capacity of 4 million tons.

Eight coal mines built with the first and second energy loans from Japan have a total production capacity of 26 million tons. Among them, the Xiqu coal mine in Gujiao, Shanxi, was completed and put into operation in 1984, producing 3 million tons of coal a year. The other seven, including the Dongqu, Zhenchengdi, and Malan coal mines in Gujiao, the Sitaigou coal mine in Datong, the Baodian coal mine in Yanzhou, Shandong, and so forth, will be completed in the Seventh Five-Year Plan period.

Also, in the past few years, China has also imported advanced coal-dressing equipment from the Federal Republic of Germany, the United States, the Soviet Union, Poland, and other countries, to build five large coal washing plants. Two of them, the Fangezhuang colliery coal washing plant of the Kailuan coal mine in Hebei with an annual capacity of 4 million tons, and the Xinglongzhuang coal washing plant in Yanzhou, Shandong, with an annual capacity of 3 million tons, have already been put into operation.

It is learned that in the Seventh Five-Year Plan, China will open nearly 100 new coal mines with a planned production capacity of 180 million tons, and that 136 coal mines will be completed and put into operation, increasing coal production capacity by 167 million tons. China will also select a number of large and medium-sized coal development projects with better conditions for expanded cooperation with foreign companies and will look for more effective ways for the use of foreign capital. China will continue to import equipment for large coal mines and opencut coal mines as well as advanced construction equipment, which cannot yet be produced at home.

12802/12899
CSO: 4013/137

NATION'S LARGEST COAL TERMINAL NOW OFFICIALLY OPEN

Beijing GUOJI SHANGBAO in Chinese 15 May 86 p 1

[Article: "China's Largest Deep-Water Coal Export Piers--the Shijiu Port Coal Piers--Now Officially Open"]

[Text] On 9 May, following state approval, China's biggest coal piers--the Shijiu Port coal piers--officially opened.

The Shijiu Port coal piers were built during the period of the Sixth 5-Year Plan. Large-scale, open-type special coal export piers, they are entirely of Chinese design and construction. The piers have a yearly handling capacity of 15 million tons. This is another project partially financed by the Japanese following the second-phase construction of the coal piers at the port of Qinhuangdao and the Yan-Shi railroad.

Shijiu Port is located in the city of Rizhao in Shandong Province some 65 nautical miles from Qingdao to the north and 44 nautical miles from Lianyungang in the south and faces both Korea and Japan across the sea. The Yan-Shi railroad will connect the port of Shijiu and the rest of the rail network in east China so that goods and materials from the northwest and the central plains can be shipped directly to this port via Xianyang, Jiaozuo, Xinxiang, Heze, and Yanzhou, making it one of China's major gateways to the sea. It will play a major role in resolving Shanxi's outshipment of coal and in promoting the economic growth of the northwest, the central plains and the eastern seaboard.

The opening of the Shijiu coal terminal gives China coal berths that will accommodate 100,000-ton vessels. The port now has the nation's largest deep-water coal piers. The construction is a major item making use of Japanese joint funding. The equipment was all assembled by the Chinese and the coal berths are up to 1980's levels.

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CSO: 4013/134

MORE RAIL CAPACITY BEING ADDED TO EASE SHIPPING BOTTLENECKS

HK240555 Hong Kong ZHONGGUO TONGXUN SHE in Chinese 1211 GMT 23 Jun 86

[Report: "China Will Build 16,000 Kilometers of Railroads To Improve Coal Transportation"]

[Text] Hong Kong, 23 Jun (ZHONGGUO TONGXUN SHE) -- According to a report from Beijing, during the Seventh Five-Year Plan period, China will rebuild some 16,000 km of main railroad in the northeast and coastal areas, to increase the railroad coal transportation capability to 650 million tons by 1990, an increase of 26 percent over 1985.

Both the industrial and agricultural output value and the railroad freight transportation volume of China's northeast and east coast areas account for about 70 percent of the country's total. Current inadequate railroad transportation services are chiefly in these main railroad lines.

"ZHONGGUO MEITAN BAO" quoted an official of the Ministry of Coal Industry as saying that in the next 5 years, China will principally improve railroad coal transportation in Shanxi, eastern Heilongjiang, and the southwest area, and will improve the transportation of three railroad lines, namely, the north, middle, and south lines, to transport Shanxi coal to other provinces and areas so that the annual transportation volume of coal from Shanxi will reach over 200 million tons by 1990, an increase of 67 percent over 1985. China will also build three multiple tracks and a new railroad line in eastern Heilongjiang to help transport coal produced by large coal mines in Jixi and Gitaihe to other provinces and areas. In addition, China will start the electrification project of the Zhenzhou-Wuhan railroad this year, and the electrification project of the Zhenzhou-Baoji railroad will also be completed, section by section, before 1988.

CSO: 4013/140

CONSTRUCTION OF 15 MODERN MINES ACCELERATED

HK040243 Hong Kong ZHONGGUO XINWEN SHE in Chinese 1249 GMT 3 Jun 86

[Report: "China Building 15 Modern Coal Mines"]

[Text] Beijing, 3 Jun (ZHONGGUO XINWEN SHE)--China is speeding up the construction of 15 modern mines which are expected to be completed in 2-3 years.

An official of the Ministry of Coal Industry told this reporter that by 1990 a large number of unified distribution coal mines will have come up to the standards of modernization and, in the future, new coal mines will also be built according to modernization standards. From now until the end of this century, China will concentrate on stepping up technological transformation in the existing 600 or so coal mines whose production is under state control so that they will gradually become modern coal mines.

Construction of the first group of modern coal mines, 15 in all, started in 1984. These mines are chiefly located in eastern and central China. There are five mines in Shanxi, including the Datong Yungang mine, the Xishan Xiqu mine, and the Luan Wangzhuang mine; four in northeastern China, including the Tiefa Xiaonan mine and the Jixi Xiaohengshan mine; four in the Huang He and Huai He basins, including the Yanzhuang Xinglongzhuang mine in Shandong and the Pingdingshan No 1 mine in Henan; one in Hebei, the Kailuan Fangezhuang mine; and one in Sichuan, the Songzao Datong No 1 mine.

It has been learned that as of last April, the level of mechanization in coal mining in seven coal mines such as Xiqu, Xinglongzhuang, Xiaohengshan, and the Datong No 1 mine, had reached 100 percent.

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CSO: 4013/132

COAL

WORK ON PINGSHUO PROGRESSING SMOOTHLY

Beijing ZHONGGUO MEITAN BAO in Chinese 12 Mar 86 p 1

[Text] Work on the Antaibao open-cut coal mine, a Sino-U.S. joint venture in Pinglu and Shuoxian counties, Shanxi, started formally on 1 July 1985. So far, both sides have lived up fairly well to their contract obligations, and the work has progressed smoothly.

According to the agreement between the two sides, the U.S. side will hold the leading positions, and the Chinese side the positions of deputies, of the coal mine in the first 12 years of its operation. As of now, the 38 major managerial positions on the U.S. side and a similar number on the Chinese side for the coal mine's eight departments have largely been filled, and they have begun to work together.

As of the end of the last year, more than 465 million dollars had been invested in the project, about 40 percent of the estimated total investment. In the 6 months from ground-breaking to the end of the year, 4.95 million cubic meters of earth had been stripped, overfulfilling the planned figure by 65 percent. In the industrial area and auxiliary projects, two highways with a total length of 30 kilometers had been opened to traffic; the 8.25-kilometer-long main part of a river diversion project was completed; water supply source, water pipelines, temporary power supply, oil depot, 110,000-volt permanent power transmission towers and lines, office buildings and other construction projects were completed or basically completed. Railway bridges were erected before the Spring Festival this year, and trains can run to the industrial zone. Two stories of the six-storied steel structure of the main plant building of the coal washing plant have been installed.

In the living area, buildings have a total floor space of 280,000 square meters, of which 200,000 square meters have been completed. A bachelors' dormitory, dining room guesthouse, three apartment houses for single men or women, a primary school, child-care center, general office building, and family housing units totaling 91,700 square meters in floor space have been completed and made available to users. Basic living conditions have been provided for both Chinese and foreign employees.

By the end of the last year, 95 pieces of various types of mining, transportation and earth-moving equipment had been delivered safely to the mine, weighing a total of more than 16,000 tons. Of these, 78 have been assembled and are up

to quality standards. Through the assembling, a group of technical personnel have been trained. So far, 312 skilled workers at the coal mine have received specialized training, and some management personnel and workers have been sent abroad for observation and training. The 142 workers who have already been assigned jobs are able to perform production work according to modern standards.

There are still some problems between the two sides in cooperation and coordination. For example, there are problems about fuel oil supplies, foreign exchange loans and land requisition on the Chinese side, and the supply of working drawings on individual projects on the American side. Efforts are being made to strengthen coordination and solve the problems.

An on-the-spot work conference held recently by the Ministry of Coal Industry decided that the general goal for the construction of the open-cut coal mine in 1986 is to follow Comrade Hu Yaobang's instruction to "start operations and meet production goals on schedule," which he gave during his inspection tour of the Pingshuo mining district, and complete the various engineering projects on schedule and making sure that they are up to standards qualitatively and quantitatively. With the exception of the coal washing plant production system, railway and communications projects, the entire industrial area should be completed, checked and accepted and put to use. Construction of the runway and facilities at the airstrip should begin in May and should be completed for use by the end of the year. Construction work in the living area should be finished completely before the end of the year.

12802/12859
CSO: 4013/129

NEW SHANDONG MINE PASSES CHECKS

OW101919 Beijing XINHUA in English 1458 GMT 10 Jun 86

[Text] Jinan, 10 Jun (XINHUA)--A new large-scale coal mine in Yanzhou in east China's Shandong Province, with a design annual production capacity of 3 million tons, passed state checks today.

It is the first fully-mechanized mine ever designed in China, according to Chen Dun, vice-minister of the coal industry.

Development of the mine, one of the country's key projects, started in 1977 and it went into trial production at the end of 1985.

Yanzhou is a new coal field. It has proven deposits of over 6 billion tons and an estimated deposit of 25 billion tons, Chen said.

It now has five pairs of shafts in operation and two pairs under construction, with a total production capacity of 12.8 million tons.

During the 1986-90 period, three pairs of new shafts will be built to increase the annual production capacity by some 10 million tons.

By the end of the century, it is expected to produce more than 30 million tons of coal a year.

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CSO: 4010/58

IMPROVED SUPPLY OF MATERIALS TO COAL INDUSTRY OUTLINED

Beijing WUZI GUANLI [MATERIAL MANAGEMENT] in Chinese No 4, 20 Apr 86 pp 14-15

[Article by Zhou Yimin [6650 3015 3046] and Zhang Du [1728 6757], of the Material Supply Bureau, Ministry of Coal Industry: "Maintaining Reform, Strengthening Supply and Management of Materials for the Coal Industry"]

[Text] Coal is China's major energy source, accounting for about 72 percent of the country's energy resources. China's coal reserves are abundant and include a wide range of varieties. Coal output has increased rapidly, from 32.4 million tons in the early post-liberation period to 850 million tons in 1985, the second highest in the world. To insure continuing growth of coal production, the coal industry's material supply departments have made a serious effort to reform the material supply system and organize resources from more channels. Fairly good economic results have been achieved.

1. Reforming the material supply system under the mining bureau. The more than 600 pairs of coal pits of the 96 coal mines whose products come under unified state distribution are largely scattered in remote mountainous areas. Material management has long been a problem: Materials are purchased by many departments and piled up in warehouses at each level, resulting in slow turnover and low efficiency. Beginning in 1980, we implemented a centralized and unified management system--centralized management of funds and materials and unified planning, ordering, distribution, management and control--in a number of mining bureaus on a trial basis. Basically, the system gives the mining bureau's material department sole authority in purchasing and distribution of materials and management of reserve funds. It is responsible for all the purchases and payments. A coal mine is an internal accounting unit of an enterprise. Materials required by a coal mine, which come under unified state distribution and are controlled by the ministry, are supplied through the mining bureau's material department based on quotas set by the overall plan. Small quantities of local materials may be purchased directly by the coal mine within limits set by the mining bureau. In the present situation of insufficient material supplies and varying prices, the new management system makes it possible to concentrate the limited resources, insure supplies according to plans and allow flexibility in management; it reduces overstocking, speeds up the movement of materials and cuts down interest payments on reserve funds and loans; the material supply personnel, responsible for both materials and

money, can make careful calculations, compare quality and prices in placing orders and save money in every deal; with centralized purchasing, orders are bigger, which makes it easier for enterprises to organize production and helps bring prices down; and the concentration of funds is conducive to the development of joint ventures and cooperation to solve material shortages. Facts have proven that this new management system can better meet the mining bureaus' production and construction needs. For example, since the Xinwen Mining Bureau adopted this new management system in 1980, it has been able to increase coal output while reducing the need for reserve funds year after year; the amount of working fund required per ton of coal dropped from 6.87 yuan in 1980 to 5.1 yuan in 1985, and the turnover period for working funds was shortened from 184 days to 140 days; by making the best possible deals, 1.58 million yuan was saved from purchases in 1985 alone; with centralized control of materials, the mining bureau's capacity to meet emergencies and provide disaster relief has been enhanced; and the cost of materials per ton of coal, calculated in terms of comparable factors, has dropped year after year.

2. Organizing resources and insuring supplies by opening up more channels and reducing intermediate links. The large quantities of materials required by coal mines, whose products are under unified state distribution, have long been supplied by the state through mandatory planning, and certain items which are not available domestically are imported with state-allocated foreign exchange. In the past few years, in the area of material circulation, China has been gradually reducing the scope of distribution under mandatory planning, while expanding the scope of guidance planning and market regulation. With the decision-making power of the productive enterprises expanded, materials that come under regulation by the market are also increasing. In the face of this new situation, we began to organize sources of goods, opening up more channels and reducing intermediate links, and have done a fairly good job in meeting the coal industry's needs for materials in production and construction. Our methods are mainly: 1) Purchasing directly from the market, or using coal in cooperation in exchange for, some materials such as steel, cast iron, cement, timber, machinery and electrical products. 2) Developing compensation trade, or raising funds for joint ventures. We raised 12 million yuan from the mining bureaus and entered into joint ventures with three local glass factories in Qinhuangdao, Shazhou, and Xingtai, and each year we can get 500,000 cases of glass, more than what is allotted by the state. We also invested in local ironworks and electric cable plants in order to get the materials we need. 3) Increasing the production capacity of factories (farms) run by the coal departments themselves. For example, the production of our own cement plants reached 3 million tons in 1985, and our ironworks can produce 50,000 tons of pig iron each year. We have developed a total of 5.1 million mu of timberland with a combined annual yield of about 100,000 cubic meters of mine timber. 4) Developing sources of new materials and substitute materials. For example, we have organized production of woven plastic bands as a substitute for galvanized iron wires, and trial uses have shown good results.

In view of frequent natural disasters faced by coal mines, we set up a system of material reserves at the ministry and mining-bureau levels to help strengthen the coal mines' ability to cope with emergencies. The mining bureaus are responsible for the production reserves (including materials in

circulation), and the ministry's supply bureau is responsible for the special reserves and reserves for disasters and accidents.

3. Implementing the system of contracted economic responsibilities to achieve higher efficiency and better results in material circulation. In order to fulfill the overall task of increasing coal output by 40 million tons each year from 1985 through 1990, we have implemented an all-round system of contracted economic responsibilities based on the principle of combining responsibility, power and interests. The material supply bureau has signed an economic contract with the ministry, undertaking to supply the materials needed for the production and construction, meet the major targets for material consumption, fulfill the targets set for profits or losses and maintain reasonable stocks and special reserves. Under the mining bureaus, it is the responsibility of the material supply departments to make sure that production and construction materials are supplied according to plans, that the use of reserve funds does not exceed specific limits, that material consumption does not exceed quotas, specific quantities or limits, that reasonable stocks of materials are maintained and that the cost of materials per ton of coal is held within limit. Under the economic contract system, the ministry supplies materials to the mining bureaus according to plans, and no additional supplies will be granted; the mining bureaus supply the mines according to their quotas and will charge them for additional supplies; and the mines supply the production districts and sections according to specific material consumption limits set for them, and will reward those who practice economy and punish those who exceed the limits. In each unit, the contracted responsibilities are divided and assigned level by level and item by item down to each work shift and team and individual, whose performance will be examined strictly, and rewards or punishment will be made accordingly.

4. Strengthening control over use of materials and reducing consumption. One-third of the cost of coal production, by coal mines whose products come under unified state distribution, goes for materials, and materials account for 50-60 percent of the cost of their capital construction projects. Reducing material consumption, therefore, is of great significance for reducing the cost of materials per ton of coal and improving the coal mines' economic performance. Our work in this area includes four main aspects:

a. Innovation in pit props and supports. In the past, most coal mines used timber for props and supports, which were wasteful, costly and unsafe. With increasing mechanization and coal pits extending into greater depths, tunnels become bigger and require stronger props and supports. In the past few years, we have actively promoted the use of (guang bao mao pen) props in rocky tunnels, hydraulic supports at coal faces, and ladder-type steel props and steel arches with plastic supports, using as much plastic materials in place of steel as conditions permit, in (dong ya) tunnels. These innovations have produced notable economic results. According to statistics, by 1985, non-wood props were used for about 76 percent of the coal faces on record and for about 78.5 percent of the tunnels by length. The use of mine timber has dropped sharply. In the early 1960's, the production of every 10,000 tons of coal required 260 cubic meters of mine timber. In 1985, this was reduced to 70 cubic meters, saving 410,000 cubic meters of timber for that year. The percentage of lost metal props, beams and trestles dropped to 2.4 per

thousand, 46 per thousand and 3.1 per thousand respectively in 1985, lower than the standards set by the ministry.

b. Establishment of a material consumption quota system (to set quotas, fixed quantities and limits). Material consumption quotas are determined generally by the empirical-statistical method, actual investigation, or technical calculation. The quotas so determined should be of an advanced nature, as they will be used as the basis for planning, distribution and evaluation. At least 80 percent of the materials supplied according to plans should be placed under the quota system.

c. Strictly implementing the policy of reward for those who practice economy and punishment of those who exceed quotas in the use of materials. Beginning in 1978, we adopted a policy of reward or punishment in dealing with the problem of missing wooden and metal pit props and the use of gunpowder and measures to subsidize the recovery of waste and used materials--to control material consumption by economic means. Fairly good results were achieved. In accordance with the spirit of the State Council's directive on rewards for savings on 10 kinds of raw and semifinished materials, we conducted experiments in selected units in 1982. In 1984, all coal mines, whose products come under unified state distribution, began to assume full responsibility to keep the cost of materials used per ton of coal production within limit. The costs of materials per ton of coal represents mainly the costs of wooden pit props, substitute pit props, gunpowder, detonators, large-sized items, replacement parts, special tools, labor protection devices, coal for miners' own use and other materials and rewards for material savings. Based on a unit's supply quotas, a limit is set for the cost of materials per tons of coal produced by it. This limit is translated into responsibilities distributed by contracts at each level from the top down to the work shift, work team and individual. A cash award of 10-20 percent is given for the amount saved, and a 10-20 percent fine is imposed for the amount used beyond the limit. Awards are given mainly to workers and staff members of production districts and sections, and a small portion is given to relevant business sections and offices. At the Kailuan Majiagou colliery, known for its success in keeping cost of materials per ton of coal pretty well within limit, contracts are signed at the colliery, mining district and individual levels along six lines in production and construction; a centralized supply management system has been set up; and rewards and penalties are carried out as promised. This has fired the enthusiasm of all concerned. The colliery's cost of materials per ton of coal was 7.26 yuan in 1985, 1.36 yuan lower than in 1984, which was no small success at a time when costs of raw and semifinished materials and transportation was going up.

d. Stepping up the recovery and re-use of waste and used materials. Some of the materials used in coal production can be recovered and used again. For this, the coal mines have set up full-time underground recovery teams to recover specific kinds and quantities of wastes to be processed and re-used. Each mining bureau also holds one or two mass campaigns each year to clean up and recover waste and used materials, a part of which is repaired and put back to use.

Efforts in these areas have paid off. Despite rising prices, the cost of materials per ton of coal was only 8.01 yuan in 1985, 0.22 yuan lower than in 1983.

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BRIEFS

PLANS FOR MINE APPROVED--Beijing, 8 May (XINHUA)--Construction plans for a major coal mine in northern Shaanxi Province have passed state appraisal, the PEOPLE'S DAILY reported today. The appraisal board consists of 80 experts from the State Council's Energy Development Office, the State Planning Commission, and the ministries of coal, railways and communications, the paper said. Shenfu coal mine, expected to produce 5 million tons a year, will be built in 1990. High-quality coal deposits have been found in a 15,000-square-kilometer area between Shenmu and Fugu counties. Encouraged by the provincial government, a number of medium-sized and small coal mines run by localities and peasants have already cut the coal here. A railway between Baotou, one of China's iron and steel bases in Inner Mongolia, and Shenmu County is being built and will transport coal when completed in 1988. [Text] [Beijing XINHUA in English 0104 GMT 8 May 86 OW] /12913

COAL INDUSTRY INVESTMENTS--Beijing, 12 June (XINHUA)--The government will increase its spending on coal mining facilities by 67 percent over the next 5 years, according to the Ministry of Coal Industry. A 5-year record 31.5 billion yuan will be spent between 1986 and 1990, compared with 18.8 billion yuan in the previous 5 years. The investment will ensure the construction of 108 coal mines, of which 24 are expected to go into production this year. [Text] Beijing XINHUA in English 1207 GMT 12 Jun 86 OW] /12913

PANJI NO 1 DRESSING PLANT--It has been learned from the Huainan Coal Mine Construction Company that China's first domestically designed, 3-million-tons-per-year-capacity dressing plant will soon go into production. The plant, the Panji No 1 coal dressing plant is now undergoing the final stages of equipment installation and civil construction. The Panji No 1 coal dressing plant is located to the west of the Panji No 1 Coal Mine's main auxiliary shaft. The raw coal produced by the mine will go directly from the pit mouth to the dressing plant via conveyor belt where it will be processed and then shipped to Baoshan Iron & Steel in Shanghai and to other places. The dressing plant is Anhui's largest such facility and is comprised of seven shops. The civil construction is now 85 percent complete and the main part of the project is in its final stage. [Excerpts] [Hefei ANHUI RIBAO in Chinese 28 May 86 p 1] /6662

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OFFSHORE OIL OFFICIAL COMMENTS ON EXPLORATION PROSPECTS

HK180309 Hong Kong SOUTH CHINA MORNING POST in English 18 Jun 86 Business Post p 2

[Report by Paul Sham]

[Text] The overall success rate of China's oil exploration program should not be regarded as disappointing, according to Mr Qin Wencai, president of the China National Offshore Oil Corp.

Referring to the dry holes drilled in some contract areas, Mr Qin said "We are still in an early exploration stage with only very little work done."

For example, he said only 34 wildcats were drilled over an area of 150,000 sq km in the Pearl River Basin.

Mr Qin's remarks, apparently aimed at maintaining the interest of foreign oil companies in the country, are contained in the Oil and Gas News Yearbook, recently published by Al Hilal Publishing (Far East) Pte Ltd.

China has a vast offshore area, of which the continental shelf covers about 1 million sq km within the 200 meter depth line, he added.

"There is no reason to think it disappointing or hopeless to find large oil fields in China's offshore areas."

Through bilateral negotiations and the first round of bidding, a total of 23 petroleum contracts were awarded to 32 oil companies from 12 countries, covering an area of 93,000 sq km.

By the end of July last year, 100 exploratory wells and 59 development wells were drilled.

Mr Qin also confirmed earlier reports in the SOUTH CHINA MORNING POST that concessions have been given to facilitate cooperation with foreign oil companies.

In addition to the call for bids, he said China will cooperate with foreign companies by extending the exploration period.

Adjustments to the size of contract areas, or signing contracts in new blocks could be done through bilateral negotiations, he said.

In the second round, he said only 12.5 percent royalty will be deducted for oil fields with annual production of less than 1 million tons.

Mr Qin called for closer links with Southeast Asia, saying technological exchanges with the region will be increased in the future.

"We are all developing countries with similar marine geology. Thus, we have more in common in how to develop the petroleum industry and in handling the cooperation with foreign companies," he said.

Apart from business relationships, Mr Qin said China is willing to contract projects overseas, extending the country's oil exploration activities beyond Chinese waters.

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PETROLEUM INDUSTRY'S RECORD-BREAKING PERFORMANCE REVIEWED

Hong Kong CHING-CHI PAO-TAO [ECONOMIC REPORTER] in Chinese No 16, 28 Apr 86 p 34

[Article by Zhang Chengzhi [1728 2110 1807]: "New Prospects for China Petroleum Industry"]

[Text] The Sixth Five-Year Plan period was one of the best periods in the history of the development of China's petroleum industry.

The writer has learned from the Ministry of Petroleum Industry that during the Sixth Five-Year Plan period, extensive, rich oil and gas deposits were discovered in more than 30 places, that the verified new oil deposits are more than 1.5 times that in the Fifth Five-Year Plan period and that the increase in reserves has outstripped the increase in output. Breakthroughs were made in the exploration of composite oil and gas fields in the northeast, Shandong, Bohai Bay, marking the beginning of a new period of discoveries. With increasingly deeper understanding of the basic geological structure of the oil- and gas-bearing sedimentary basins in east China and the mechanism of their formation and evolutionary process, the petroleum departments have basically grasped the laws and characteristics of the distribution of oil and gas in this region, leading to increasingly higher standards and better results of prospecting. A series of important discoveries have been made in both old and new areas. For example, several large oil fields with a geological reserve of more than 100 million tons, such as the Gudong oil field, have been discovered; and breakthroughs have been made in the exploration of the overthrust zones in the west. In the northwestern part of the Junggar Basin, the oil-bearing formations of the Karamay oil field have been expanding continuously, and new layers of oil deposits have been found repeatedly beneath oil fields already under exploitation. Rather good oil and gas deposits and new traps of oil are discovered in the Jurassic and Triassic strata in the Beisantai area, in Kelameili, eastern Junggar Basin. High-yield oil and gas fields have been found in the Kekeya area in the southern part of the Tarim Basin, the largest sedimentary basin in China, and high-yield oil and gas wells have also been sunk in the northern part of the basin. Prospecting has also been stepped up on the old oil fields in the Qaidam Basin, and high-yield new oil and gas reserves have been found.

While prospecting continues for new reserves, crude oil output has increased year after year. China's crude oil output increased from 101.22 million tons in 1981 to 124.84 million tons in 1985, at an average annual rate of 5.3 percent. Despite high water content, the Daqing oil field has maintained stable output with some increase: Its crude oil output increased from 51.75 million tons in 1981 to more than 55 million tons in 1985, and it has maintained stable output for 10 years running. The Shengli oil field increased its crude oil output by more than 4 million tons in 1984 an again in 1985, and its total crude oil output increased from 16.11 million tons in 1981 to more than 27 million tons in 1985. The Liaohe oil field and the Zhongyuan oil field have both increased crude oil output by more than 1 million tons in the past 2 years.

At the same time, new progress has been made in petroleum prospecting and development technology. During the Sixth-Five Year Plan period, the petroleum industry further strengthened scientific and technological research and popularization work, completed 20 national-level key scientific and technological research projects and 398 ministry-level research projects and solved a series of technological problems in production and construction. Now the petroleum departments have, in the field of geological theories, basically grasped the characteristics and laws of the composite oil and gas fields in east China and, in the area of prospecting and exploitation means, mastered the digital seismic, computer processing, high-pressure-jet drilling, directional drilling, thick oil extraction and other techniques and technologies. Through many years of practical work, and in the light of geological features, they have also summed up a set of scientific prospecting and exploitation procedures. In order to speed up the modernization of China;s petroleum industry, the country spent 1.8 billion dollars to import 14 items of rather systematic advanced technologies and equipment including digital seismographs during the Sixth Five-Year Plan period. The development, popularization and application of petroleum technology have provided the technological insurance for the exploration of the complicated underground conditions and the prospecting and exploitation of oil and gas.

Cooperation with foreign countries in prospecting and exploitation of offshore petroleum resources was another achievement of China's petroleum industry in the Sixth-Five Year Plan period. Up to the present, China's largest cooperation project with foreign countries is in petroleum. According to statistics, China has used 1.7 billion dollars of foreign capital for exploration of offshore oil. Through bilateral negotiations and competitive bidding, China so far has signed 28 petroleum exploitation contracts, covering a total area of 250,000 square kilometers, with 39 firms of 12 countries. In the past few years, offshore oil exploitation has developed step by step; more than 240,000 kilometers of seismic survey lines have been shot; more than 110 exploratory wells have been drilled; 83 geological structures have been explored; and 23 oil- and gas-bearing structures have been discovered. The development of oil and gas fields has made steady progress. The Chengbei oil field in the Bohai has been put into partial production, and full operation is expected to start in 1986. Oil fields in the Beibu Gulf will also begin trial production in 1987. The exploitation and utilization of gas fields in the South China Sea are also being vigorously pushed forward. At present, cooperative exploitation of offshore oil between China and foreign countries is developing in the three vast sea areas of Bohai, South China Sea, and the

Yellow Sea, and prospecting, development and production are moving forward simultaneously.

While China's petroleum industry develops rapidly, its economic performance is also improving. During the Sixth Five-Year Plan period, the petroleum departments turned over to the state 32.24 billion yuan in taxes, profits and energy funds, 2.49 times the total state investment in the petroleum industry in this period. More than 96 million tons of crude oil were exported during this period, earning more than 18 billion dollars in foreign exchange.

An official of the Ministry of Petroleum Industry told the writer that the Seventh Five-Year Plan period is crucial to the development of China's petroleum industry. The goal for petroleum production set by the ministry is: By 1990, annual crude oil output is expected to reach 150 million tons, and a foundation should be laid for the further development of the petroleum industry in the next 10 years.

To achieve the above-mentioned goal, the Ministry of Petroleum Industry has laid down the following principle for petroleum exploration during the Seventh Five-Year Plan period: Top priority should be given to prospecting work to find more reserves, especially large new oil and gas fields. During this period, prospecting work will continue to be focused on the east to further expand the scope of exploration in the east region and locate new geological reserves. At the same time, vigorous efforts should also be made to explore petroleum resources in the west region and offshore.

In oil field development and crude oil production, attention should be focused mainly on the six major oil fields of Daqing, Shengli, Liaohe, Zhongyuan, Huabei, and Dagang. They account for 89 percent of China's total crude oil output this year. This should be increased to 92.5 percent in 1990.

Equal attention should be paid to the exploitation of natural gas as to the exploitation of oil. While continuing to expand the natural gas zones in Sichuan, vigorous efforts should be made to explore new areas and open up a few new gas-bearing zones. While carrying out technical transformation of the old oil fields, new oil fields should be developed completely with new techniques and new technologies, such as airtight conveyance of oil and gas and multi-level separation, to fully recover and utilize the oil and natural gas resources.

Vigorous efforts should be made to accelerate progress in science and technology. It is necessary to further develop trade and scientific and technological exchanges with foreign countries and continue to import advanced foreign technology and equipment. Imported advanced technology should be digested and assimilated and translated into productive forces as quickly as possible. Through efforts made during the Seventh Five-Year Plan period, our major techniques and technologies in petroleum exploration and exploitation should be brought up to the world level of the early 1980's, and we should overtake other countries in certain aspects.

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WANG TAO REVIEWS ACCELERATING GROWTH OF NATURAL GAS INDUSTRY

Chengdu TIANRANQI GONGYE [NATURAL GAS INDUSTRY] in Chinese Vol 6, No 1, 28 Mar 86 pp 1, 2

[Article: Talk by Minister of Petroleum Industry Wang Tao on Rapid Development of China's Natural Gas Industry]

[Text] Comrade Wang Tao, head of the ministry of Petroleum Industry Ministry recently gave a talk on accelerating development of China's natural gas industry. He said: "Development of natural gas should be placed in a position of importance equal to that of the development of petroleum, and development of petroleum and natural gas production should be coordinated and kept abreast of one another." He also said, "Natural gas output should be greatly increased so that China's natural gas becomes an important energy source for developing the national economy."

Comrade Wang Tao said: "Energy sources are one of the weak links in China's economic construction and in view of the present stage of development, natural gas which is one of the energy sources is very uncoordinated. Viewed from the perspective of development trends in petroleum and gas energy worldwide, from 1970 to 1984 world crude oil output increased from 2.32 billion t (tons) to 2.7 billion t, a 16.4 percent in the 14-year period, but in the same period, natural gas increased only from 1 trillion m^3 to 1.7 trillion m^3, an increase of 65 percent. From this it is clear that the trend in world oil and gas development is for natural gas development to be much faster than that of crude oil. There are reasons for this. One is that some large gas fields have been found and the other is that there is much less capital construction involved than there is for crude oil. Calculated on the basis of 1000m^3 of natural gas being equal to it of crude oil, the ratio of world average total oil and gas production is 1:0.63. For some major oil producing countries such as the United States and the Soviet Union it is roughly 1:1. The Soviet Union's natural gas is a little bit more than oil production. But the situation in China, seen in terms of oil and gas production for 1985, however, is 1:0.1, a ten-fold difference. This lack of coordination is not due to our shortage of gas, but mainly a result of treating gas as incidental in exploration. But in fact, the theoretical guidance for finding gas and oil and the extraction technology are not the same. In the past we only stressed finding oil and did not pay attention to finding gas. Therefore, although we talk about

simultaneous development of gas and oil, when the subject is raised it is always connected with oil and gas is never brought up. Now, we should resolve this problem in terms of thinking, direction, and policy and place oil and gas on a footing of equal importance."

Comrade Wang Tao said: "Great quantities of gas exist in coal-bearing layers. China's oil and gas basins are mainly continental basins, and the coal-bearing layers in continental basins are especially rich. It should be said that there is quite a lot of coal-generated gas and coal layer gas. We still do not have accurate resource estimates, although we have some, they are very inaccurate. This is because in the past this area was researched very little and in terms of theory and method we still cannot reflect objective reality. Seen from the perspective of this superficial evaluation, China's natural gas resources at a minimum are several tens of trillions of cubic meters, but currently the natural gas reserves we have found amount to less than 1 trillion cubic meters. This indicates that the potential for China's natural gas industry development is fairly considerable. If only we would pay serious attention to this area, our natural gas could be developed more rapidly so that natural gas would become an important energy source for China's economic development.

"China's natural gas industry appeared a rising force in the last year of the Sixth Five-Year Plan due to stress on natural gas exploration." Comrade Wang Tao continued, "In the test extractions in the Shayi section of the first well on the Bohai-Chengbei oil platform, the condensate extracted daily was over 200m^3, natural gas was 500,000m^3; the second well was not bad either. The third well was drilled to the middle of an ancient submerged granite mountain, and daily crude oil production was 635t, while natural gas was over 40,000m^3. Now in the belt from Gudong to Wuhaozhuang, a gas-bearing zone of as much as 400km^2 has been discovered. The Yinggehai Basin in the south appears to be a large gas area. Now, the one S-31 structure alone has reserves of 90 billion m^3, and for our country that is also very large. Surrounding this gas field there is also a group of structures and a series of structures which have not yet been explored."

On land there have also been many discoveries. First of all there is Sichuan. Sichuan is now China's main gas-producing area and in addition to verified Triassic and Permian series, new oil-bearing layers have also been discovered in Carboniferous and Sinian series. At the same time, even more important is the discovery an area of nearly 20,000 km^2 of Permian organic reef limestone in east Sichuan and west Hunan and Hubei. These are very good geological conditions for finding new gas-bearing areas in the future. The discovery of the second gas area is the oil field in the Puyang region. Here not only is there oil-associated gas in Triassic strata, but also a natural gas deposit was discovered under this layer. In view of the output from a single well, output is very high; oil field comrades estimate that the gas-bearing area may be 500km^2, of course this will have to be further verified. Nevertheless, within this 500km^2 if we drill to the strata at this depth, natural gas is discovered. This is an extraordinarily good situation. The third is an area in

central Hebei. Last year, after making breakthroughs in the Wen'an-Suqiao area, a natural gas field was discovered. In November of this year we formally shipped gas to Beijing, 100,000m^3 per day, and in the first period of the project it will supply 400,000m^3 per day. Looking to the future, if we continue to make discoveries in this area then it is possible it will continue to increase. This year we also drilled some industrial oil and gas wells in the Langfang area. Fourth, the Shaanxi-Gansu-Ningxia area. In a fault-folded belt on the western edge of the Ordos Basin now in an area east of the Ningxia Autonomous Regions' Wuzhong two gas fields have been discovered in succession in Carboniferous and Permian series. From the perspective of the geological situation, this may be a string. Of course, it still awaits further exploration. Here we have very rich coal-associated gas and excellent geological conditions. We estimate that this area may become a gas-bearing area. Fifth, in the Great Northwest, the situation is even more encouraging. Through preliminary seismic explorations in the famous Tarim Basin, the smallest structure is 1,000-2,000km^2. The Shashen No 2 well drilled by the Ministry of Geology and Mineral Resources and the Kekeya[2688 0344 0068] structure drilled by the Southern Xinjiang Headquarters are both only on the very border, but one well's daily oil production is several hundred m^3 or more than 1,000m^3, and daily gas production is over 2 million m^3. In the Qaidam Basin in Qinghai, good oil and gas has been seen in structure in Nanyishan and Shizigou. The former produces 500m^3 of oil and 500,000m^3 of gas daily, and the latter produces 1,010m^3 of oil and 160,000m^3 of gas daily.

Comrade Wang Tao said: "During the Seventh Five-Year Plan while continuing to expand the Sichuan natural gas area, we will actively explore to develop new areas and strive to open several new gas bearing areas and zones. By 1990 we plan to produce 16 billion m^3 of natural gas and in terms of standard equivalent, this is the same as annual output of 16 million tons of crude oil. At the same time resource preparations should be made for natural gas development in the next ten years."

"During the Seventh Five-Year Plan we should build new oil fields which are at the level of the eighties, do our utmost to use advanced technology, carry out automation of production, compeltely hermetic shipment, and multilevel separation of oil and gas to fully recover and use coal-accompanied gas and light hydrocarbons. Old oil fields which have already been developed should be technologically reformed in a planned way in accordance with the demands of lowering consumption and reducing energy use. This matter is extremely important. To tell the truth, the comprehensive utilization of our present oil and gas is still at a fairly low level. Generally calculated, the money wasted each year in processing natural gas alone could be several hundred millions. The natural gas from some oil fields is now released into the air and lost. This is an obvious waste. And there are some not so obvious, and those are the great quantity of light hydrocarbons in the natural gas beginning with ethane and counting up: ethane, propane, butane, pentane. But if we can separate these things out through multi-level processing, it would be fairly valuable. In economic terms, it is worth quite a bit of money. The price of our crude oil now is 120 yuan/ton, and the negotiated price is 470-540 yuan/ton; in the past export light

crude was $300 per ton, but now it is about $230 per ton. If we can recover the light hydrocarbons, figuring roughly, by 1990 we can recover 1.5 million tons per year, and in terms of the cash value, it would be equivalent to an income of 1 billion yuan. But now we only recover a small part, and the larger part is burned off. If these light hydrocarbons are further utilized what results might it produce? If the recovered light hydrocarbons in the natural gas go through just dehydrogenation, that is, if the ethane and propane were turned into ethylene and propylene, which are the basic raw materials of our chemical industry, using their polymers, they can become polyvinyl and polyacrylic. One ton of polyvinyl is 2,300 yuan; using this kind of raw material to extend production, one ton of raw material could produce plastic products worth 8,000 yuan; if we carry out the processing deeper, and turn it into film which can be stretched in two directions, that could turn one ton into 16,000 yuan. Therefore, it is extremely important that we should seek the technology from science and the funds from management and utilize our petroleum and natural gas resources comprehensively."

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CHINESE SCIENTISTS DEVELOP NEW THEORY TO FIND OIL

Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 10 May 86 p 1

[Article by XINHUA reporter Zhu Wenzhi [2612 2429 1807]]

[Text] Applying a new theory on composite (traps) pools of oil and gas, Chinese petroleum geological workers have contributed to the development of the Shengli oil field.

The geological structures of the Shengli oil field's composite oil and gas pools at Jiyang are complex. The four major geological structures in the area, from the pre-sinian stratum, which was formed 2.5 billion years ago, to the paleozoic stratum, the mesozoic stratum and the cenozoic stratum, formed 10-20 million years ago, all contain petroleum; oil and gas deposits have been discovered in sandstone, conglomerate, limestone, dolomite, mudstone, igneous rock, granite and gneiss formations; and layers of oil lie buried from about 600 meters to 5,000 meters underground. In the early period of exploration and exploitation, oil appeared suddenly, only to disappear as suddenly; suddenly there was a layer of oil, and next it was a layer of water; oil layers were found to run in an up-and-down pattern and vary in thickness; and the oil was sometimes heavy and sometimes light. It was confusing, and there appeared to be no law to follow.

After a long period of exploration and study, Chinese petroleum geological workers summed up a new theory on China's composite (traps) pools of oil and gas and gradually understood the geological features of the composite (traps) pools of oil and gas and the laws governing the formation, distribution, and concentration of oil and gas, and they have initially developed a set of prospecting techniques for this type of complex oil and gas deposits. By applying the new petro-geological theory, a series of important breakthroughs were made at the Shengli oil field in exploration during the Sixth 5-Year Plan period. High-yield oil wells have been drilled in places where oil and gas deposits were once thought to be low, and a number of new oil fields have been discovered.

Petroleum experts point out that in the 30-odd years since liberation, there have been two major breakthroughs in the development of China's petroleum industry. The first is the discovery of the Daqing oil field, which enriched and developed the theory on continental basin oil formations. The second is

the development of the theory on composite oil and gas fields in fault or depression basins based on long practical experience gained in oil fields in eastern China, including the Shengli oil field. This theory is of great significance to the exploration and exploitation of the oil fields around the Bohai.

Based on this theory, the Shengli oil field has so far discovered 52 oil fields, of which 32 are being exploited. Large oil deposits have been found in Gudong, Wuhaochu, Chunxi, Liuhu, Niuzhuang and other areas.

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BRIEFS

NATURAL GAS OUTPUT TO RISE--Beijing, 2 Jun (ZHONGGUO XINWEN SHE)--This reporter has learned from the Ministry of Petroleum Industry that in the next 5 years, China will build three major natural gas producing areas in Sichuan, Nanhai, and Bohai Bay so that the annual output of gas will reach 16 billion cubic meters by the end of the Seventh Five-Year Plan, an increase of around 33 percent over 1985. The focus of China's gas building at present is to strengthen prospecting work and provide more reserves. China's gas reserves in 1990 will increase by over 100 percent over the present. China now has more than 100 large, medium, and small gas fields. The output of the Sichuan gas field, which is the largest, accounts for over 40 percent of the nation's total. Large-scale prospecting for gas in this area has a history of more than 30 years. In the years to come, Sichuan will continue to prospect for high-yield gas fields, gradually perfect the pipeline network within the province, and set up a special gas pipeline in northern Sichuan. It has been reported that in the next 5 years, gas reserves and output of the Zhongyuan, Huabei, Shengli, Liaohe, and Dagang oil fields in the Bohai Bay area in eastern China will increase by big margins. Meanwhile, the gas resources of Nanhai and Yinggehai waters will also be exploited steadily. [Excerpts] [Hong Kong ZHONGGUO XINWEN SHE in Chinese 0805 GMT 2 Jun 86 HK] /12712

DAQING TOPS OUTPUT TARGET--Harbin, 30 Jun (XINHUA)--Daqing, China's largest oil field, in Heilongjiang Province, has pumped out 192.62 million bbl as of today, topping its semi-annual output quota. An oil field official said today Daqing's daily output has been at the peak level of 1.07 million bbl since last month. "We're taking every possible measure to meet this year's quota of 388.5 million bbl to cope with the increasing domestic demand," he said, adding that Daqing produces half of China's crude oil. [Text] [Beijing XINHUA in English 1339 GMT 30 Jun 86] /9604

DAQING REPAYING LOANS--Harbin, 4 Jun (XINHUA)--China's largest oil field, Daqing, is heading for big new profits by sinking wells in perimeter areas with the help of bank loans, an oil field official said today. The oil field in Heilongjiang Province has borrowed 810 billion U.S. dollars in three loans from the Bank of China and a Japanese bank since 1983 to drill in six nearby areas. Almost 100 wells were sunk the following year. By end of last year, Daqing had earned 350 million yuan (about 110 million U.S. dollars) from 900 million barrels of oil produced at these wells, and this year it repaid the first loan of 76 million U.S. dollars. [Text] [Beijing XINHUA In English 1417 GMT 4 Jun 86 OW] /12624

BEIBU WAN UPDATE--Guangzhou, 6 June (XINHUA)--The first offshore oil field in the Beibu Gulf in the South China Sea will officially go into production in August, an oil field official said here today. With equipment installed by a Singapore company, the Wei 10-3 oil field near Weizhou Island in the northeast Beibu Gulf was discovered jointly by the Chinese Offshore Oil Corporation and the French company, Total, during cooperation between 1980 and 1984. Four wells were sunk during the cooperation period. Two of them each produced more than 7,000 barrels of oil per day. Since 1984, the two companies have invited international tenders for construction and installation of production equipoment, and have sunk six more test wells. [Text] [Beijing XINHUA in English 1346 GMT 6 Jun 86 OW] /12913

TARIM STRIKE--Urumqi, 23 June (XINHUA)--Two wells have struck oil of commercial value in the Tarim Basin, said an official of the Petroleum Bureau of the Xinjiang Uygur Autonomous Region in northwest China. Thirty prospecting teams with 6,000 geologists have been searching for oil and gas in the basin since last March. The Tarim Basin, which covers 530,000 sq km, is the largest sedimentary basin in China. The region's crude oil output is expected to be from 50.4 million to 56 million bbl by the end of this century, an increase of 15.4 million bbl over 1985. [Text] [Bejing XINHUA in English 0557 GMT 23 Jun 86 OW] /12232

NEW SHANDONG FIELD--Jinan, 1 July (XINHUA)--A new oil field producing 80,500 bbl a day went into operation near the [Huang He] in Shandong Province today, following 100 days of development. The Gudong oil field will help the Shengli oil field in the same province approach the production level of Daqing, China's largest oil field, in Heilongjiang Province, by the end of this decade, a Shengli oil field official said. More than 30,000 workers have drilled 416 wells at Gudong, 381 having gone into operation since March 21. They have also laid 321 km of oil and gas pipelines, erected 148 km of power transmission lines, and built 10.7 km of dikes to protect the oil field from seawater encroachment. [Text] [Beijing XINHUA in English 1455 GMT 1 Jul 86 OW]

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ROLE OF NUCLEAR POWER IN CHINA'S FUTURE ANALYZED

Beijing ZIRAN BIANZHENGFA TONGXUN [JOURNAL OF DIALECTICS OF NATURE] in Chinese No 2, 10 Apr 86 pp 25-35

[Article by Guo Xingqu [6753 2502 3255] of the China Atomic Energy Scientific Research Institute]

[Text] Foreword

In a study about the history of energy development in various countries, it is pointed out by the World Energy Conference that because of the long construction period and long life of energy-related facilities (coal mines, oil fields, thermal power plants, hydroelectric power stations and nuclear power plants), major changes in the energy system such as energy production, transmission, and conversion will generally require more than 50 years. For this reason, accurate long-range forecasts are very important in establishing long-range policies for energy development.

Prior to the 1970's, energy forecasts were generally accomplished by compiling past statistical data and extrapolating into the future based on some mathematical formula. However, after the 70's, using this method to predict the future often failed because of economic crises, rising energy cost, and political unrest. Consequently, some scholars have proposed methods which involve postulating several possible future scenarios based on past experience and current development trends, and using computers to calculate the possible consequences produced by these scenarios. Some scholars took into the account the elements of uncertainty in the mathematical models by using the theory of probability and replaced the deterministic models by probabilistic models. Because the human brain is clearly superior to computers in the areas of fuzzy discrimination, judgment, deduction, and inference, there is an increasing trend to combine the analysis and judgment capabilities of the human brain with computers to study extremely complex problems such as the energy problem which involve the interaction of many different elements.

China's energy production and consumption had experienced several large fluctuations; hence it is difficult to find a formula that can be used for reliable forecasting. Not only are China's energy products grossly underpriced, its domestic price structure is also extremely unreasonable; adjustments in these areas are necessary but will require a very long time.

In particular, since China's energy system is expected to undergo major changes in the next century, it is even more difficult to use the method of extrapolation for long-range forecast.

In the early 70's, the U.S. Government established a plan for large-scale development of nuclear power within this century. But as a result of the economic crisis in the late 70's and the wide-spread anti-nuclear syndrome after the Three Mile Island accident, this plan was all but abandoned. Since that time, orders for 100 nuclear power plants with a total capacity of approximately 100 million kW have been cancelled; certification of nuclear power plants now requires 5 to 6 years compared to about 1 year in the past. A nuclear power plant that can be completed within 5 to 6 years in France or Japan will take more than 10 years in the United States; in a country with high interest rates, this becomes an important factor which limits the economic feasibility of nuclear power plants. Some American scholars even believe that the end of nuclear power is forthcoming. One group of scientists went so far as to construct a scenario where nuclear energy, hydropower, and geothermal energy will all disappear before the year 2050, and U.S. energy needs will be satisfied by solar energy, energy from organic substances, wind energy, and small amounts of energy from fossil fuels.[1] This viewpoint was also echoed by Toffler in his book "The Third Wave."[2]

Since 1984, the viewpoint put forward in "The Third Wave" about future energy resources has received a great deal of attention in this country; many well-known scholars have written articles and given speeches about the unique importance of solar energy in the future. Under these circumstances, it is essential to conduct a serious study on possible future scenarios of China's energy resources and about China's long-range strategy.

In this article, the author presents a mathematical model which is based on past conditions in this country and abroad, and on the current trend of scientific and technological development; it also takes into account such factors as economic development, population growth, environmental impact, technical feasibility, and economic considerations. Calculated results based on this model are used to study the development of various energy resources, with emphasis on analyzing the role of nuclear power in China's future energy supply. As a large number of studies had been conducted by Chinese scholars on the problem of energy resources in this century, these results will be used as the foundation for studying China's energy problem during the 21st century.

I. Significant Growth in China's Total Energy Consumption in the Next Century

Today, China ranks third in the world in terms of energy consumption, next to the United States and the Soviet Union. But due to its large population, the per capita energy consumption in China is only one-third of the world average. The per capita land mass, cultivated land, forest resources, grasslands, water resources, and most minerals in China are much lower than the world average. Ideally, China's population should not exceed 500-600 million. Song Jian[3] et al., have calculated the trend of China's population for the next 100 years based on a β value (the average number of births per female during her

lifetime) of 1.5. Since birth control has not been widely accepted in regions of minority people and in many farm villages, the β value before the year 2000 is expected to be slightly higher than 1.5; as cultural standards are raised and family planning becomes accepted by the majority of the population, the β value after the year 2000 will be slightly lower than 1.5; by the middle of the next century β will again start to increase. However, due to the inertia of high growth rates over the preceding 3 decades, the population will continue to grow in the early 21st century; the trend will not be reversed until after 2030. We can expect to reach the state of ideal population only in the 22nd century.

Recently, the Communist Party Central Committee established a strategic policy to catch up with the developed nations by the 100th anniversary of the People's Republic. Even though our economic development had taken a detour over the past 30 years, China's current high economic growth rate fully demonstrates the superiority of the socialistic system. By learning from past experience, China's future growth rate will be even higher, and we are fully confident that our goal will be realized. We shall postulate two different scenarios of economic development: in one scenario the per capita output is assumed to reach 10,000 U.S. dollars (based on the 1980 dollar) by the year 2050; in another scenario the per capita output is assumed to be 7,000 dollars by 2050. The growth rate is expected to be quite high during the early part of the 21st century; as the per capita output increases, and the base number rises, the growth rate will gradually decrease.

In this article, standard coal is used as the unit measure of energy, 1 kg of standard coal generates 7,000 kcal of heat. The relationship between energy and economic development can be expressed in terms of the coefficient of elasticity, which is the ratio between the rate of growth of energy resources and the rate of growth of the economy. A low coefficient of elasticity implies that a smaller growth in energy resources is required to achieve the same economic growth rate; the reverse is also true. During the early stages of industrialization, the coefficient of elasticity is greater than 1, later it drops to approximately 0.7. In this article it is assumed to be 0.63 during the period 2000-2010, after which it is assumed to gradually decrease. Based on the two postulated scenarios, China's total energy consumption in 2050 is calculated to be 7 billion and 5.5 billion tons of standard coal respectively; the per capita energy consumption is approximately 6.4 and 5.1 tons of standard coal respectively.

In 1979, the per capita energy consumption in the United States was 11.386 tons of standard coal, the per capita energy consumption in Luxenburg was even higher. In 1982, the per capita output in the United Arab Emirates was 24,080 dollars, in the United States it was 13,160 dollars. By 2050, the per capita energy consumption and per capita output in China still will not be very high, but the total energy consumption and total output will be among the highest in the world because of its large population. In order to raise China's per capita energy consumption and per capita output to world standards, it is necessary to elevate the entire economy including the energy industry, and to reduce the population; this will not happen until 100 years from now.

Nevertheless, calculations show that by 2050, China's gross national product and total energy consumption will have increased by a factor of 20-30 and 7-9 respectively from 1984. The tremendous growth in China's energy consumption will result in drastic changes in this country's energy structure.

II. During the Early 21st Century China's Energy Needs Will Depend Primarily on Fossil Fuels

In the early 21st century, due to growth in population and rapid economic development, China's total energy consumption in 2020 will be double the consumption in the year 2000; subsequently the growth rate will slow down. If China's total energy resources are divided into three categories: regenerative energy (hydropower, non-commodity energy, solar energy, etc.), fossil fuels (coal, petroleum, natural gas) and nuclear energy, then during the early 21st century China's rapid growth in total energy consumption will primarily depend on fossil fuels.

China's hydropower resources rank number 1 in the world, but it is still very limited. The annual electricity output from China's developable hydropower resources is estimated to be 1.92 trillion kilowatt-hours, which is equivalent to 700 million tons of standard coal, assuming a power generation efficiency of 33 percent for thermal power plants; it is equivalent to only 524 million tons of standard coal based on an efficiency of 45 percent. We should try our best to develop most of our hydropower resources in the early 21st century. But due to sedimentation, reservoir capacity is reduced and the actual developable hydropower resources will be smaller than the above estimates. Because of the limited hydropower resources, as development increases, the proportion of hydropower in China's energy structure will decrease from 10 percent in 2020 to approximately 6 percent in 2050, and it will continue to decrease.

The non-commodity energy resources produced by family farmers for their own consumption are expected to reach more than 400 million tons of standard coal by the year 2000. But with increasing modernization it will decrease sharply; by 2050, it will be down to 10 million tons of standard coal.

With regard to solar energy, it has been estimated that to produce an amount of solar energy equivalent to 1 billion tons of standard coal per year requires 1 to 2 billion tons of steel and concrete, and tens of thousands of square kilometers of land. The annual output of steel and concrete in the world today is around 1 billion tons; even if all the output is used to produce solar energy, or if all the factories in the world are converted to producing solar energy with the same amount of factory space, the amount of energy produced will still be quite limited. Because the cost of electricity generated from solar energy is 20 times higher than nuclear power, the French Power Co. has decided to abandon its plan of solar energy power generation. In 1985, the Soviet Union completed a solar energy power plant, but its cost of power generation is more than 10 times that of nuclear power. Since solar energy is rather low in energy flow density, and is subject to large variations due to diurnal, weather and seasonal changes, it is unlikely to

become a major industrial energy source; however, it still has great potential as an energy source for residential and special applications.

Other energy sources such as wave energy and electrical energy using differences in the temperature and salinity of sea water are theoretically promising but they are also low in energy flow densities and rather inefficient in energy conversion. Furthermore, using these energy sources requires finding solutions to many critical problems such as construction of large structures, protection against corrosion and organic deposits in sea water, and development of high-efficiency heat exchanges for operating under small temperature differences. Because of the excessive amount of materials required, these energy sources cannot be developed on a large scale. The energy source from tides that can be developed economically in this country is about 10-20 million kW, which is equivalent to only 10-20 million tons of standard coal annually.

The geothermal energy sources in China are mostly moderate-temperature sources. Because of high cost, many geothermal power plants have been shut down. Therefore, geothermal energy is expected to contribute very little to China's energy supply.

Wind energy is not only low in energy flow density, but also unreliable; hence the energy sources that can be developed economically for power generation amont to only 1 million kW. Other sources of wind energy used to power water pumps and milling machines are also very limited.

During the early part of the next century, China's primary renewable energy sources (besides hydropower) will be energy from organic substances. With increasing level of modernization, the small methane pools which provide non-commodity energy sources for the family farmer will be gradually replaced by factories producing energy from organic substances. They will become the major energy sources for rural industries. By the middle of the next century, solar energy will begin to play a significant role as a renewable energy source. Even so, the total amount of renewable energy excluding hydropower will only be about 600 million tons of standard coal by 2050, and about 1 billion tons of standard coal by 2100.

In 1984, 58.7 percent of the total electricity in France was generated from nuclear power; in Taiwan nuclear power provided 47.9 percent of the total electricity. China's first nuclear power plant will be completed by about 1990. During the early 21st century, nuclear power development will accelerate; the amount of nuclear power output in 2020 should reach a level 20 times the level in 2000. But due to the setback of more than 10 years in nuclear power development in this country, by 2020 nuclear power can only provide about 20 percent of the total energy needs.

The rapid growth in China's energy consumption during the early part of next century will have to be satisfied by fossil fuels. This requires that the rate of growth of China's fossil fuel supply must be kept at a level equal to or slightly lower than the 1980-2000 level; by 2020, it should reach about 1.8

billion tons of standard coal. If the allocation is 87 percent coal, 10 percent petroleum, 3 percent natural gas, then it requires 2.2 billion tons of raw coal, 130 million tons of petroleum and 40 billion cubic meters of natural gas. This requirement imposes a very heavy burden on resources, the environment, and transportation.

III. Nuclear Power Will Become China's Major Energy Source by the Middle of the Next Century

China has a rather limited supply of natural gas; its primary fossil fuels are coal and petroleum. According to an estimate by the World Coal Conference, China's coal reserves, which include the deeply buried, unminable thin coal layers, is about 1.4 trillion tons. Reserves which have already been identified are about 700 billion tons; if 40 percent of this reserve will be extracted, and assume that each kg of primary coal generates 5,000 kcal of heat, then 200 billion tons of standard coal can be retrieved; this number is more than twice the reserve estimated to be economically retrievable by the World Coal Conference. China's petroleum reserve is estimated to be 30-60 billion tons. Let us say it is 50 billion tons, and assume that 30 percent can be extracted; if each kg of petroleum generates 10,000 kcal of heat, then the retrievable petroleum is equivalent to 21.43 billion tons of standard coal. The sum of the coal and petroleum reserves is 221.4 billion tons of standard coal. In addition, there are other resources such as oil shale, deep-sea petroleum, deep coal mines, etc.; also, as the rate of extraction increases, it is possible that the total amount of fossil fuels retrieved during the next few hundred years will exceed 221.4 billion tons, but it is hard to imagine that the actual output will be twice this figure.

According to this article's predictions, by 2020 fossil fuels will provide 60 percent of the total energy supply. If this percentage were to hold beyond 2020, then by 2050, it will grow to 3-4 billion tons of standard coal, and by 2100, it will be 4-5 billion tons. This is clearly impossible.

The question is: can we maintain the rate of consumption of fossil fuel at a constant level of about 1.8 billion tons beyond 2020? If so, the amount of fossil fuels consumed before 2050 will be about 80-90 billion tons of standard coal, and before 2100 it will be about 150-170 billion tons of standard coal. On the surface, it would seem that China's fossil fuel resources can almost satisfy the energy needs for the 21st century, but a closer examination will show that this is not the case.

The per capita coal and petroleum resource in China is only one-half the world average, and is much lower than the level in countries rich in coal and petroleum. Both coal and petroleum are important non-renewable raw materials used by the chemical industry. The primary chemical products made from petroleum can increase in value by a factor of 10 from the original value; if it is used to produce high-technology chemical products, the value can increase by another factor of 10. A similar situation is true for coal. Therefore, more and more coal and petroleum will be used as raw materials for the chemical industry.

The consumption of fossil fuels is limited not only by available resources but also by environmental factors. In December 1952, 4,000 people died in London within 5 days because changes in weather conditions prevented smog generated by the burning of coal from dissipating. At that time, the annual load of coal burning in England was 800 tons per square km; many scholars consider this to be the environmental limit. Today, the annual coal burning load in several Chinese provinces and cities is approaching or has exceeded the 1952 level in England. By the late 20th century, the annual consumption in China will be three times the current level; at that time many provinces and cities will have exceeded the level of 800 tons per square kilometer.

Currently the amount of smog and pollutants ejected into the atmosphere in this country is about 20 million tons per year, which is twice the level of the world average. The concentration of particles, sulfur dioxide and nitrogen oxides in the air around Tian An Men Square exceeded the national standard by 2-4 times.[4] Three hundred years ago, Beijing's air was fresh and clean, and visibility was high. According to a book by Sun Chengzhe, "Tian Fu Guang Ji," written in 1671 during the Qing Dynasty, it was possible to see the Imperial City from 60 km away.[5] Today, Beijing's pollution is becoming a serious problem. In the 50's, the average number of smog days was 45; by the 70's, it had increased to 100 days; in 1980 it became 150 days, and in 1981 it reached 199 days.[6]

The coal in this country has high sulfur content. The sulfur dioxide generated from burning coal will produce acid rain and cause serious pollution problem. Generally, the rain is considered to be acidic if the pH value is less than 5.6. In 1982, rain over Guiyang had pH values as low as 3.44; in Chongqing it had reached 3.35. In the winter of 1982, the air above Beijing had 1.8 times the sulfur dioxide content it had in 1981.[7] The European Environmental Commission has passed a resolution to develop nuclear power as a measure to prevent acid rain. On 9 July 1985, more than 10 European countries established the first international agreement to limit the amount of sulfur dioxide exhaust. During the 70's, the United States invested 450 billion dollars for improving the environment; during the 80's this figure will increase to 675 billion dollars. As a result, even though U.S. coal consumption increased by 85 percent during the period 1975-1982, the concentration of sulfur dioxide in the atmosphere decreased by 33 percent.

In addition to sulfur dioxide, coal also contains benzopyrene, which has been identified as a major cause of lung cancer. In less than 10 years, the death rate due to lung cancer in Shanghai and Wenzhou increased by 50 percent.[7] In order to increase the rate of coal consumption in China by a factor of 3 by 2020 without producing excessive pollution, we must try to develop technologies for sulfur removal as well as coal gasification and liquefaction; such efforts will also improve thermal efficiency so that more energy can be extracted from coal. As China's coal consumption rate in the next century will be much higher than the current U.S. rate, it is expected that the required investment for environmental protection will also be higher.

Unfortunately, existing environmental protection techniques cannot prevent the formation of carbon dioxide. As a result of large-scale use of fossil fuels, the concentration of carbon dioxide in the atmosphere is increasing at an alarming rate. Keeling et al.,[8] made detailed measurements of variations in carbon dioxide concentration around the Hawaiian Islands. Although carbon dioxide levels fluctuate seasonally with the growth cycles of plants, the overall trend has been toward higher levels: 315 ppm in 1958 to 335 ppm in 1980, and the rate of increase is accelerating. Because of the greenhouse effect produced by carbon dioxide, the average temperature of the atmosphere will rise. Calculations by F. Niehause [9] show that if the total energy consumption in the world after 2030 increases from 27 billion to 32.3 billion tons of standard coal and maintains that level, then the average world temperature in 2100 will be 4 °C higher than in 1980; the temperature increase around the North and South Poles will exceed 10 °C, which may cause the huge ice cover over the South Pole to slide into the ocean. If this ice cover is completely melted, the sea level will rise by approximately 5 m, and most of the economically developed, heavily populated regions near the ocean will be submerged, bringing disastrous consequences to the rapidly growing world population. If nuclear power is to become the main energy source after 2020, supplemented by solar energy and small amounts of coal, the carbon dioxide concentration will gradulaly decrease after reaching a peak of 400 ppm in 2050; the average temperature in 2050 will only be 0.4 °C higher than in 1980.

In a news conference given by U.S. astronaut White on 22 April 1983, he pointed out that the earth seen from space in 1983 was considerably more polluted than what he had seen 10 years before; the dense layer of smog is turning the earth into a "grey planet." The ancient Maya society, which once had a high degree of civilization, suddenly disappeared from Latin America because of damage to the ecological environment resulting from rapid increase in population. We must not make the same mistake and destroy the only planet we all share. Early in the next century, except for a few countries where nuclear energy is being developed rapidly, most countries will still use coal as the primary energy source. For the sake of our own generation as well as for future generations, we cannot rely on coal on a long-term basis, depleting this valuable chemical raw material within a few generations and polluting the environment at the same time. By 2020, when the annual coal consumption reaches about 2 billion tons, we should try to reduce the consumption of fossil fuels as quickly as possible. According to calculations made in this article, by 2050 the annual consumption of fossil fuels will decrease to around 660 million to 1 billion tons of standard coal; by 2100, it will further decrease to below 200 million tons of standard coal. At that time, fossil fuels used in transportation will gradually be replaced by hydrogen produced from the decomposition of water. Like electricity, energy derived from hydrogen will become a widely used secondary energy source.

Based on the above hypothesis, the cumulative fossil fuel consumption during the period 2000-2050 will be about 65-80 billion tons of standard coal; the cumulative consumption during the period 2050-2100 will decrease to 16-32 billion tons of standard coal. Since this article only addresses the energy

resource problem, the above figures only include the consumption of fossil fuels as energy sources. As more and more fossil fuels will be used as chemical raw materials, the production of fossil fuels in China is expected to exceed the above figures by a wide margin. But with the rapid reduction of fossil fuels as energy sources, China's transportation industry will be relieved from the heavy burden of shipping coal and petroleum to support the rapid growth of other segments of the economy. Significant progress will be made in China's chemical industry and the developing biological industry due to the increasing supply of raw materials; this will bring increased prosperity to the economy. Also, the reduction in the pollution level will restore the beauty of China's mountains and rivers.

In order to satisfy China's growing energy needs with a limited amount of hydropower, rapid reduction in non-commodity energy sources, and limited growth in other renewable energy sources, we must rely on nuclear energy to replace the depleted fossil fuels. Starting from 2040, nuclear power will be China's main energy source. Figure 1 shows the growth in energy consumption and the allocation of energy sources in China during the next century. These curves are calculated by the author based on the postulated scenarios described above; the band around each curve reflects the range of uncertainty of the total energy consumption and each energy source.

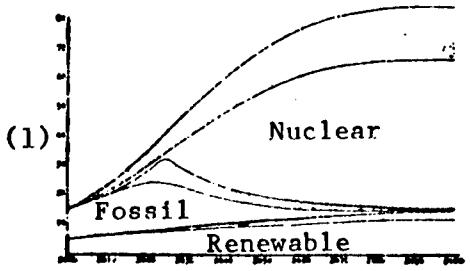

Figure 1. China's Energy Sources in the 21st Century

Key:

1. Total consumption of primary energy sources (in 10^8 tons of standard coal)

IV. The Development of Nuclear Technology Has Set the Stage for Conversion to Nuclear Energy

Nuclear Power Plant Has Become a Safe, Clean, and Economical Energy Source

Because of China's large population, low per capita energy consumption, and limited per capita resources, the conversion to a nuclear-based energy structure is not only inevitable, but also urgent. The development of nuclear technology has already set the stage for this conversion.[10],[11] Today, nuclear energy has become a safe, clean, and economical industrial energy

source. A modern reactor can produce electric power as high as 1.5 million kW, which is sufficient to satisfy the current power needs of Beijing City.

The nuclear reactor was developed in the 1940's to meet urgent military needs; the initial design was very crude, the air and water used to cool the reactor were ejected directly into the atmosphere after passing through the reactor core. Some of the minor incidents of pollution during the initial stage of nuclear development were concealed under the cover of national security. When nuclear energy made the transition from military to civilian applications, safety standards were significantly improved.

Because strong radiation is produced during the fission reaction of uranium nuclei, the nuclear reactor is a potentially dangerous energy source. In order to prevent the leakage of radioactive materials, nuclear power plants have four layers of protective shields: the first layer is the nuclear fuel core block, which is made of ceramic material with very stable physical and chemical properties, it can contain 98 percent of the fission products inside the block; the second layer is a fuel enclosure made of zirconium and stainless steel; the third layer is the pressurized container which houses the reactor core; it can prevent any radioactive material from escaping into the environment even if there is a small leak in the fuel enclosure; the fourth layer is the protective shell, which is 60-70 m tall and contains the reactor and all components directly connected to it, the shell not only can prevent radioactive materials from escaping, but also serves as a protective shield against accidental impact by a falling object (e.g., an aircraft).

The nuclear waste from the reactor is first kept in a storage pool next to the reactor; after 6 months, most of the radioactive isotopes will decay into non-radioactive stable isotopes. Then it will be shipped to a post-processing plant where any remaining useful ingredients are extracted. The liquid waste produced from the post-processing plant can be solidified using concrete, asphalt or glass, then placed in a glass-lined metal container and buried in a storage well with stable geological structure such as a salt mine. In an environment isolated from living things, the level of radioactivity of these waste materials will reduce to that of ordinary uranium after 500 years.

The amount of fuel used in a nuclear power plant is 100,000 times less than the amount of coal used in a coal-fired power plant of the same capacity; while the safety measures are expensive, they contribute little to the cost of nuclear power. As a result of these measures, nuclear power plants are much safer and cleaner than coal-fired power pants.

The high safety standards of nuclear power plants allow a maximum radiation dosage of only one-half the natural background, which is one five-thousandth of the fatal dosage. The concentration of sulfur dioxide allowed by coal-fired power plants is 300 times the natural background, which is one-fifth the fatal dosage. Because of the pollution level of coal-fired power plants is so close to the fatal dosage, there have been many incidents where people are injured.

Coal also contains a small amount of radioactive isotopes. But since coal-fired power plants handle large volumes of coal with no isolation or protective measures whatsoever, the radiation pollution level on the environment is several times that of nuclear power plants of the same size. However, the main source of pollution from coal are dust particles, nitrogen oxide, sulfur dioxide, and benzopyrene. As a result of the large amount of harmful gas and dust particles produced from coal, the Committee of Scientific Affairs of the American Medical Association pointed out in 1978 that the death rate caused by pollution from coal-fired power plants is 400 times that of nuclear power plants of the same size.

Most of today's nuclear power plants are pressurized-water reactor (PWR) power plants. The reactor is a large, high-pressure vessel over 10 m high; the cooling water which is under a pressure of more than 150 atmospheres and a temperature of 330 °C carries the heat generated by the fission process to the steam generator. This heat is absorbed by water outside the steam generator tubes and converts it to high temperature steam which drives the turbine/generator unit. The most serious accident that may occur with this type of reactor is when cracks develop in the cooling water pipes, causing water to leak out. When this happens, even though the reactor is shut down immediately, the decay of the fission products will continue to generate heat which cannot be carried away, thus raising the temperature of fuel enclosure to the point that it is severely damaged; as a result, radioactive materials will escape into the environment. This type of accident is called the loss-of-water accident.

On 28 March 1979 at the U.S. Three Mile Island power plant, a loss-of-water accident occurred that shook the world; the accident was a result of the failure of workers to open the valves of a backup system during inspection and error by the operator in closing the water inlet valves of the reactor. Fortunately, timely activation of the water injection system and the carefully designed safety shields prevented this accident from causing damage to the public. Only three workers on the scene received radiation and there were no casualties. The primary radioactive material which leaked into the environment through the protective shell was iodine-131; the amount of leakage was only one-thousandth of the amount released from an accident of a British military reactor in 1957, and one-fifth of the amount released from an accident of a U.S. military reactor in 1961. The Three Mile Island accident proved in a negative sense that nuclear reactors are safe. Since the accident, the number of cumulative hours of nuclear reactor operation has doubled the amount before the accident. Because of tighter safety measures, no similar accident has occurred.

Due to the high safety standards, the basic construction cost of nuclear power plants is generally 1.5-2 times the cost of thermal power plants of the same size. But the fuel cost of nuclear power plants is much lower than that of thermal power plants; therefore, the cost of power generation for nuclear power plants is 50-90 percent less.

Today, the United States has the largest number of nuclear power plants. But since the 70's, the rate of growth of nuclear power has slowed because of economic crises and vacillating policies. France on the other hand, followed a steady nuclear energy policy and quickly advanced to the number 2 position in the world.[12] The Soviet Union has the richest fossil fuel resources and is also the largest exporter. However, in view of the safety, cleanliness, economy, and low transportation cost of nuclear energy, many party congresses since the 70's have considered nuclear energy development as one of the most important issues. At the end of 1984, its total power output ranked third in the world--66.6 percent of France's output and 31.2 percent of the United States' output, but it was in the process of implementing the world's largest nuclear power plan. The number of nuclear power plants under construction in the Soviet Union is 128.7 percent that of France and 72.9 percent that of the United States; the number of nuclear power plants being ordered is 9.39 times the number in the United States and totals 56.74 percent of all the nuclear power plants ordered in the world. The Soviet Union will soon surpass France in nuclear power and may surpass the United States before the end of this century. Because of the huge investment and the long cycle involved in nuclear power development, it is necessary to have a stable political and social environment. Therefore, the Soviet experience will fully demonstrate the superiority of a planned economy in nuclear energy development.

We Must Prepare for the Transition From PWR to Fast Reactors

China has already begun its development of PWR nuclear power plants. The uranium which exists in nature is called natural uranium. It contains 0.7 percent of U-235 and very small amounts of U-234, the remainder is non-fissionable U-238. Although the PWR has become a safe, clean, and economical industrial energy source, it can only use U-235. During the fission of a U-235 nucleus, it absorbs one neutron and releases on the average 2.43 fast neutrons. In order to increase the probability of triggering the fission process of other U-235 nuclei by the fast neutrons, they are first slowed down to become thermal-neutrons in first-generation reactors such as PWR's; hence these reactors are called thermal-neutron reactors. In a PWR, one of the 2.43 neutrons released in a fission process is used to trigger the fission of the next U-235 nucleus in order to maintain the chain rection. Other neutrons are absorbed by non-fissionable nuclei or escape through leakage; only 0.6 neutrons would be available to convert the non-fissionable U-235 to easily fissionable plutonium (Pu)-239. Of course, not all U-235 nuclei participate in the fission process; therefore, the number of usable uranium nuclei in a PWR is less than 1 percent of that found in natural uranium. In view of the rapid growth of nuclear power plants around the world, it is expected that early in the next century, uranium resources that can be extracted economically will be depleted.

Some Chinese scholars suggest the use of thorium. Also, during the Carter administration in the United States, significant efforts were dedicated to the promotion of thorium technology in order to minimize the danger of proliferation of nuclear weapons. But the use of thorium still requires consuming large amounts of uranium; furthermore, the nuclear waste from thorium fuel is

difficult to treat because of the high level of radioactivity. As a consequence, this policy died in its infancy. Some experts have suggested using an accelerator to convert U-238 into Pu-239, but technical difficulties prevented it from being implemented. In comparing the various schemes proposed during the past few decades, the fast-neutron reactor, or simply the fast reactor, is the only practical scheme that can solve the problems facing nuclear energy development today.

The fast reactor uses Pu-239 produced by thermal-neutron reactors as its primary fuel. It uses the fission-produced fast neutrons directly to trigger other fission process rather than slowing them down first to thermal-neutrons, as in a thermal reactor. Although fission of Pu-239 can also take place in a thermal reactor, it only produces a limited number of neutrons. However, in a fast reactor, the fission of Pu-239 can release more than 2.6 neutrons; also, the probability of absorption of fast neutrons by non-fissionable nuclei is reduced. Thus, in a fast reactor, not only enough neutrons are released to maintain chain reaction, but there are more than 1.2 neutrons available from each fission process to convert U-238 into Pu-239. In other words, in a fast reactor, for each plutonium-239 nucleus that is "burned up," 1.2 new Pu-239 nuclei are created. Thus, by continually supplying U-238 to the fast reactor, the amount of nuclear fuel will continue to increase. Theoretically, almost all the uranium atoms can be used up in a fast reactor, but in reality, due to conversion loss, only 70 percent can be utilized; this is 80 times higher than that in a PWR. Consequently, even the low-quality uranium mines become economically viable for extraction. Thus, the amount of uranium resources that can be used by a fast reactor is not only 80 times that of the PWR, but several thousand, or even several hundred thousand times.

The development of a new reactor generally must go through the process of developing a small experimental reactor, a medium size demonstration reactor, and finally a marketable commercial reactor. The United States was the first country to develop the fast reactor. In 1946, the United States built the first fast reactor; in 1951, the United States first used the fast reactor for power generation. In 1971, President Nixon decreed the development of fast reactor to be a national goal, and announced the decision to build a 380,000-kW demonstration fast reactor at the Clinch River site. But since the plutonium obtained from a fast reactor is better suited for military use than that obtained from a PWR, many oppose the development of fast reactors for fear of proliferation of nuclear weapons. With the change of administration, the decision to build the Clinch River fast reactor has not been made and the construction cost has increased many times. This politically induced cost increase became a weapon used by the opponents of fast reactors. In December 1983, the U.S. Congress decided to cancel this project due to excessive cost overrun; as a consequence, in the fast reactor race, the United States fell behind other countries such as France, the Soviet Union, England, Japan, and West Germany. However, fast reactors are essential for the United States. Therefore, the Department of Energy is planning to start over and develop a modular type fast reactor.

The development of fast reactor in France on the other hand, has been supported by a steady nuclear policy and proceeded along a correct path; it advanced quickly with only a moderate amount of investment, and surpassed the United States, England, the Soviet Union to become the leader of the world. In 1967, it built the "Rapsody" experimental fast reactor; in 1974, it completed the "Phenix" demonstration reactor, and in 1985, it completed the 1.2 million kW fast reactor, the "Super Phenix," which was the largest in the world. However, the "Super Phenix" was considered only as a commercial test reactor; the French believe that a commercial fast reactor must generate 1.5-2 million kW of power to be economically attractive. In the near future, France will begin construction of a 1.5 million kW commercial fast reactor, the "Super Phenix-2." The Soviet Union built a 600,000-kW demonstration fast reactor in 1980, which was the largest at that time; now it is building a 800,000-kW fast reactor, and it has plans to build a 1.6 million-kW unit in the near future.

The levels of India's per capita output, and economic and industrial resources are lower than those of China, it places very high priority on the development and utilization of nuclear energy. No only has it designed and built its own nuclear reactor, but in 1985, it completed an experimental fast reactor based on imported French technology, thus capitalizing on the 10-20 years of experience in research and development in the United States, the Soviet Union, England, and France. In addition, it developed and used the advanced carbide nuclear fuel in the experimental reactor. It also plans to build a demonstration fast reactor in the 90's; at that time, India may even surpass the United States in fast reactor development.

Actual experience has shown that building a second-generation reactor--the fast reactor--is well within current technology. But due to the increased expenditure in solving complex technical problems of the fast reactor, within the foreseeable future it is still difficult to compete with the PWR in terms of power generation cost. It is expected that by early next century, when economically-extractable uranium resources are nearly depleted, when the accumulation of plutonium from thermal-neutron reactors continue to increase, and when fast reactors become further improved technically and more competitive economically, then the era of large-scale utilization of fast reactors will begin.

The development of fast reactors in China had an early start, but the early effort stagnated; as a result, the current status is far behind India. Because of China's large demand for nuclear energy and the limited amount of uranium reserve that can be used for the PWR, the transition from the PWR to fast reactors is not only inevitable but also very urgent. In order to study China's nuclear energy development from the point of view of nuclear fuel cycles, the unit of nuclear energy in Figure 2 is expressed in terms of thermal power. The demand for nuclear energy and its range of variation as reflected in Figure 1 are expressed as a band in Figure 2. In calculating the demand for nuclear energy, we have taken into consideration the fact that the efficiency of power generation will be increasing and a small part of nuclear energy will be used directly in the form of heat. Even so, if only PWR's are

used to satisfy the nuclear energy demand indicated in Figure 2, 2.4-2.9 million tons of natural uranium will be required by 2050 and 10-13 million tons of natural uranium by 2100; clearly these are much greater than China's extractable uranium reserves. In this article, it is assumed that the development of PWR will follow a trend indicated by curve 1 in Figure 2; by the year 2000, it will reach 8 million kW of electric power, by 2020 it will reach 65 million kW, and by 2030 it will reach 70 million kW before development stops; by 2060 all PWR's are expected to be retired from service. This scenario requires 260,000 tons of natural uranium, of which 30,000 tons are needed before 2010. Here, we have considered the increasing demand for natural uranium before 2000, and the increasing fuel consumption in PWR's after 2000. If fast reactors are not developed, curve 1 clearly shows that China's nuclear energy requirement will not be satisfied, and 260,000 tons of uranium will be unacceptable. Assume that China can develop an experimental fast reactor in 1995, a demonstration reactor in 2005, and begin using advanced fast reactors with carbide nuclear fuel in 2010, then since the demand for natural uranium before 2010 is less than half the estimated uranium reserve, and the utilization efficiency of uranium will be enhanced by the development of fast reactors after 2010, the requirement of 260,000 tons of uranium becomes acceptable. Furthermore, because of the increased utilization efficiency of uranium, this supply of natural uranium will be able to satisfy China's nuclear energy needs for the 21st century.

If we assume that the plutonium produced by PWR's and fast reactors is used to develop carbide fuel fast reactors, then the nuclear energy provided by both fast reactors and PWR's is shown as curve 2 in Figure 2. It can be seen that even if we begin developing fast reactors immediately, there will still be a gap between the energy supply and China's growing demand for nuclear energy during the period 2020-2030; not until 2040, when sufficient number of fast reactors and abundant nuclear fuel become available, the energy supply will begin to satisfy or exceed the demand. In other words, based on the projected maturity of fast reactor technology and carbide nuclear fuel technology, it is entirely possible that nuclear energy will become China's main energy source by 2040. By that time, the supply of nuclear fuel will no longer be a limiting factor for nuclear energy development.

As a result of the abundant supply of nuclear fuel and the development of temperature-resistant helium turbines and helium-cycle blowers, the PWR may be replaced as the primary thermal-neutron reactor by the high-temperature gas-cooled reactor which has higher power generation efficiency, uses less coolant water, and is also safer and cleaner.

Hybrid Reactor--A Bridge Between Fission Reactor and Fusion Reactor

Both thermal-neutron reactors and fast reactors use the energy released from the fission of heavy nuclei. Energy is also released during the fusion of two light nuclei into a heavy nucleus.

When two nuclei carrying a positive charge undergo fusion, they must first overcome the static repulsive force acting between them; hydrogen nuclei are

prime candidates for fusion because they carry very little charge. Among the three isotopes of hydrogen, fusion is more likely to occur between deuterium and tritium than between deuterium and deuterium. The amount of energy released from the fusion of each kg of deuterium or tritium is 4.14 times that released from the fission of U-235. There is abundant supply of fusion fuel on earth. The amount of uranium in the ocean is several hundred times that found on land, and the amount of deuterium in the ocean is more than 10,000 times than the amount of uranium--almost 40 trillion tons. The fusion energy produced by this fuel will be able to satisfy the energy needs of many generations to come.

Fusion produces very little radioactive materials, and generates no residual heat. Therefore, it is safer and cleaner than fission because the danger of a Three Mile Island accident is eliminated.

Since the discovery of fission in 1938, significant advances have been made in the research and implementation of nuclear fission. Fusion was discovered 5 years earlier than fission, and in 1952 a fusion bomb was successfully exploded. But up to now, we have not been able to produce useful energy by controlled fusion.

The research and implementation of fission have progressed smoothly because in fission, neutrons are used to bombard U-235 and other nuclei. Neutrons can easily penetrate nuclei because they do not carry electric charge. Furthermore, in the fission of U-235 nuclei, more neutrons are released; consequently, the intensity of fission reaction can be easily regulated by controlling the neutron reproduction process.

A fundamental difficulty of controlled fusion is that before two nuclei can be fused, they must first overcome the strong repulsive force between them. After more than half a century of dedicated efforts to solve this problem, victory appears to be in sight. It is anticipated that a few years from now, the United States, the Western European countries, the Soviet Union, and Japan will succeed in demonstrating a fusion process where the energy released will be comparable to the energy level required to initiate the process; they will also achieve the ignition of a fusion reactor. Since the development of the fission reactor, dozens of different types of reactors have been proposed and compared before a few most promising reactor types were selected. It is expected that with the development of various types of fusion devices, a similar competitive selection process will take place. Because of the highly complex technologies of fusion reactors, the selection process and the process of developing a practical commercial fusion reactor will be much more difficult.

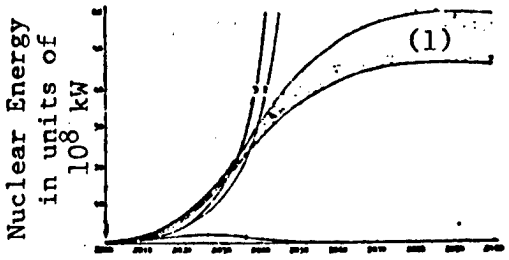

Figure 2. Development Trend of China's Nuclear Energy in the 21st Century

1. PWR
2. Carbide fuel fast reactor developed on the basis of curve 1
3. Fast-fission hybrid reactor and carbide-fuel fast reactor developed on the basis of curve 2

Key:
1. Amount of nuclear energy needed

Eighty percent of the energy produced from the fusion of deuterium and tritium is carried by neutrons. Not only do these neutrons have high energy levels, but the number of neutrons released by the fusion of deuterium and tritium is an order of magnitude higher than that released by the fission process of U-235. In 1953, Bowell suggested the construction of a fusion-fission hybrid reactor, where neutrons produced by the fusion process are used to transform U-238 and Th-232 into Pu-239 and U-233, and to trigger nuclear fission. Recent advances in fusion research makes this idea seem feasible. However, the future evolution of the hybrid reactor is very difficult to predict at this time.

Assuming that the development of China's hybrid reactor is only 25 years behind fast reactor, by 2020 small hybrid reactors will be built to produce plutonium for carbide-fuel fast reactors, then the supply of nuclear energy will be shown as curve 3 in Figure 2. In this case, China's nuclear energy development by 2030 will be able to satisfy or exceed the demand. If the development of fast reactor can be accelerated and the reproduction of its nuclear fuel can be increased, then the demand for nuclear energy can be satisfied by 2020.

The development of the fast reactor and hybrid reactor will provide enough time for mankind before the arrival of the era of pure fusion reactors. The above analysis shows that the high growth rate of China's energy supply in the 21st century is not only necessary but also possible. In order to ensure that this possibility will become a reality, we must have a comprehensive

long-range strategy for energy development and must begin to take a series of necessary measures now.

V. Suggested Current Policies and Measures To Prepare for the High Growth Rate of China's Energy Supply in the 21st Century

The above analysis shows that in order to catch up and surpass the standards of developed nations in the next century, we must solve two very important and difficult problems: population and energy. Other problems are either of less importance or not as difficult. Extensive studies of the population problem by Chinese scholars have provided the scientific basis for establishing China's population policy. The energy problem on the other hand involves many different issues and is difficult to characterize mathematically by only a few simple parameters; therefore, it is still a controversial topic among many scholars.

In studying the long-range strategy for China's energy development, we must consider the overall development trend of the world's energy resources as well as China's domestic conditions; we cannot simply adopt other countries' experience or base our policy on premature opinions expressed by individuals in foreign literature. Because of China's low per capita energy consumption and large population, in order to carry out the party's strategic plan and to ensure the continuing growth of China's economy, it is expected that China's total energy consumption will increase substantially in the next century. Due to China's late start in nuclear energy development, and the limited supply of other energy resources such as hydro power, wind energy, geothermal energy, tidal energy, solar energy, and energy from organic substances, the increasing energy demand during the early part of the next century must be satisfied primarily by fossil fuels.

But the use of fossil fuels leads to severe pollution problems. In view of the environmental limitations, the high cost of transportation, the limited per capita fossil fuel resources, and the increasing use of fossil fuels as raw materials for the chemical industry, China's fossil fuel consumption should reach about 2 billion tons of standard coal by 2020, then stabilize at this level for a few years before dropping sharply. At that time, the continued growth of China's energy needs can only be satisfied by nuclear energy. By 2040, nuclear energy will become China's primary energy source. Because of the low efficiency of uranium utilization in PWR's and the limited uranium reserves, the rapid growth of China's nuclear energy after 2020 must rely on fast reactors.

The main purpose of studying the strategy of long-range energy development is to plan our immediate action on the basis of scientific analysis of projected energy development. The analysis presented in this article shows that the first half of the next century, particularly the first 30 years, will be the most difficult period in terms of China's economic development. Even though China has already taken measures in family planning, the population early in the next century will continue to increase; not until the middle of the next century will it return to the current level. In terms of energy supply, the

first half of the next century will be a period when China's energy system undergoes major changes: on the one hand we must complete the transition from fossil fuel to nuclear energy, on the other hand we must convert from thermal-neutron reactors to fast reactors, and also make every effort to develop hybrid reactors. By the second half of the next century, the population will begin to decrease; the major changes in the energy system will have been completed and a solid foundation of nuclear energy development will have been established. The growth in per capita output and per capita energy consumption will largely be the result of reduced population. At that time, China's economy will truly enter a period of coordinated development.

In order to reach the goal of China's energy industry in the next century, we should take the following measures before the end of this century:

First, we must accelerate the development of nuclear energy. If we continue to postpone its development China's energy industry in the next century will face an even more difficult situation. Because of the long development cycle, we must carry out the following tasks in order to accomplish the transition from thermal reactors to fast reactors: In conjunction with nuclear power development, establish a PWR-based nuclear industrial system as the foundation for China's large-scale nuclear energy development; in the 1990's, complete the construction of an experimental fast reactor and begin development of a demonstration fast reactor; also, initiate preliminary research on a hybrid reactor.

Second, because of the delay in nuclear energy development, China's main energy source early in the next century will still come from coal. In order to improve the efficiency of coal utilization and to minimize pollution, efforts should be made to develop such technologies as sulfur removal, coal gasification and liquefaction. To reduce the burden of coal-based energy production, we should also try to develop most of the hydropower resources before 2020. In addition, we should increase the area of forest coverage and use wood-burning stoves and methane pools as a basis for developing organic energy facilities.

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QINSHAN PROJECT DIRECTOR: CHINESE PLANT NO 'CHERNOBYL'

Shanghai JIEFANG RIBAO in Chinese 22 May 86 p 2

[Article by staff reporter Xu Zhiquan [1776 1807 6898]: "Is the Design of the Qinshan Nuclear Power Plant Safe and Reliable?--Interview with Wang Dingquan, director, Shanghai Reactor Engineering Research and Design Institute"]

[Text] As the Qinshan Nuclear Power Plant in Zhejiang was entering the stage of full-scale construction, an accident of radioactive leakage occurred at the Chernobyl Nuclear Plant in Ukraine, USSR. Many readers in Shanghai and the Shanghai Economic Zone are very concerned over whether a similar accident could happen to the Qinshan Nuclear Power Plant. For this reason, I paid a visit to Comrade Wang Dingquan [3769 7844 6898], director and senior engineer of the Shanghai Reactor Engineering Research and Design Institute of the Ministry of Nuclear Industry, who is in charge of the Qinshan nuclear power plant project.

Comrade Wang Dingquan stated positively that there are three solid shields outside the reactor of the Qinshan nuclear plant to insure its safety and reliability. He explained that early in the design stage of this nuclear power plant, a serious and careful study and analysis was conducted by the designers on all kinds of accidents which had occurred at nuclear power plants around the world. Under the guiding principle of "safety first, quality first" for the design, three safety shields are to be built around the Qinshan reactor: The first is a high-strength zirconium alloy shell. The second is an airtight pressure-resistant low-allow steel high-strength pressure container. And the third and outermost is a completely sealed safety shell with an inner lining of 6-millimeter-thick steel plate and an outer shell of 1-meter-thick prestressed reinforced concrete. The safety shell has an inner diameter of 36 meters and a total volume of 55,000 cubic meters, and each square meter can take enormous pressure. Like an impregnable castle, it safeguards the purity of the atmosphere outside of the reactor. Even in the event that the first two safety shields are damaged and radioactive gases are released into the safety shell, the maximum pressure that can possibly be produced is still far below the pressure that can be borne by the safety shell. Moreover, the radioactive gases tightly confined in the safety shell will be neutralized immediately by an automatic sprinkling device containing liquid sodium hydroxide in the safety shell. An important cause of the leakage of

radioactive matter after the accident at the Chernobyl Nuclear Power Plant was that the plant did not have a third shield--a completely sealed safety shell. Therefore, when the reactor was on fire, large quantities of radioactive matter rushed out of the reactor, causing serious pollution of the environment surrounding the power plant.

Comrade Wang Dingquan told the reporter that at present there are 366 nuclear power plants with various types of reactors in the world, and that 56 percent of the reactors are of the pressurized-water type. This is the type of reactor to be used in the Qinshan Nuclear Power Plant. The uranium rods in the core of the reactor are surrounded by incombustible pressurized water, forming an incombustible environment for the reactor core. The Chernobyl nuclear plant uses graphite water-cooled reactors, which are no longer used by other countries. Once the cooling system breaks down in a reactor of this type under high-temperature conditions, the protective gases will leak out, or the leaked steam will react with the zirconium, generating a large quantity of hydrogen and causing an explosion, which will accelerate the rupture of the pipelines and make it impossible for cooling water to get into the reactor, resulting in the leakage of large quantities of radioactive matter.

"What other protective measures have been adopted for the safety system in the design of the Qinshan Nuclear Power Plant?" To this question, he answered in no uncertain terms that in addition to the three shields, five major safety measures have been adopted. First, the availability of emergency power supply. In the event two outside power supply lines are both cut off, the nuclear power plant's own three diesel generators will start automatically to generate electricity in 12 seconds, insuring normal power supply for the safety and protective systems. Second, earthquake-resistant measure. Even when an earthquake of a magnitude of 7 on the Richter scale occurs, the reactor is designed to stop operation automatically. Third, fire-prevention measure. The nuclear power plant is built entirely with fireproof materials, and fireproof cables are used for the entire power supply system. When there is a short-circuit or other fire situation, the electric cables will not burn. Fourth, measure against typhoons and sea tides. The Qinshan Nuclear Power Plant is located on the East China Sea coast. Three rows of sea walls with a maximum height of 8 meters will protect the power plant and the reactor from threat. Fifth, measures to stop the reactor automatically. When the reactor develops trouble or runs in excess of the permissible level, 37 sets of control rods will fall into the reactor automatically by gravitational force, halting the operation of the reactor.

Comrade Wang Dingquan said in conclusion: Like coal mines and oil fields, a nuclear power plant should also be viewed on a long-term basis, and it can have accidents of one kind or another. But the safety and protective measures adopted in designing the Qinshan power plant are such that there can be no major accidents, much less the kind of disaster that occurred at the Chernobyl nuclear plant.

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LI PENG VISITS DAYA BAY SITE, STRESSES SAFETY

Beijing RENMIN RIBAO (OVERSEAS EDITION) In Chinese 22 May 86 p 1

[Text] Li Peng, vice premier of the State Council, made a special trip to Guangdong to inspect the construction site of the Daya Bay Nuclear Power Plant. After the inspection, he called for nuclear power projects to always follow the principle of attaching primary importance to safety and quality. He said that it is necessary to be extremely serious about the safety of nuclear power plants and adopt still more effective measures to make sure they are safe.

Yesterday morning, Vice Premier Li Peng and his party arrived at the Guangdong joint nuclear power company. He met with some of the Chinese and foreign engineers and management cadres working in the company and made a speech. Referring to the major accident at the Chernobyl nuclear power station in the Soviet Union and the lessons to be drawn, he said that the accident has aroused extremely deep concern among people of all walks in China. The most important lesson we should draw is that in the entire course of a nuclear power plant's construction and future operation and power generation, we must always adhere to the principle of attaching primary importance to safety and quality. We must not feel relaxed and slacken our vigilance because the Guangdong nuclear power plant has adopted the pressurized water reactors, which are technologically more advanced and safer than those in the Chernobyl nuclear power plant. On the contrary, we must take a serious attitude and adopt effective measures to insure the safety of nuclear power stations.

Li Peng mentioned the five safety measures which are being adopted.

--The State Council has established a State Nuclear Safety Bureau, which is reponsible for the drafting of laws, regulations and standards concerning peaceful use of nuclear energy in China and the supervision of their implementation. At present, the bureau should focus its work on supervising the design standards and construction quality of the Qinshan Nuclear Power Plant and the Guangdong Nuclear Power Plant now under construction. For this reason, it is necessary for the State Nuclear Safety Bureau to set up nuclear safety supervision stations in the Qinshan and Daya Bay areas.

--The safety standards used for Guangdong Nuclear Power Plant are guaranteed.

--A complete scientific quality control system should be set up during the construction of a nuclear power station.

--The formation of a well-trained operational force is the key to insuring the future safety of a nuclear power plant in power generation.

--China is willing to learn from the advanced experiences in the construction and operation of all nuclear power plants in the world, and welcomes and supports international technical cooperation and exchange of information on the safety and management of nuclear power plants.

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NUCLEAR POWER PLANTS COULD BE GENERATING POWER BY 1989

Beijing RENMIN RIBAO [OVERSEAS EDITION] in Chinese 22 May 86 p 1

[Article by XINHUA reporter Zhang Huchen [1728 5706 5256]]

[Text] Chen Zhaobo [7115 5128 0590], Chinese vice minister of nuclear industry, said yesterday that in the next 5 years, China will begin to use electricity generated by nuclear power plants on the precondition that primary importance is attached to safety and quality. Nuclear energy will gradually become China's second energy source aside from the traditional energy resources.

Chen Zhaobo said: The first stage construction of the Qinshan Nuclear Power Plant in Zhejiang, a 300,000-kilowatt generating unit designed and built in China, is scheduled for completion and operation in 1989. The second stage construction of the Qinshan plant, including the nuclear reactors for two 600,000-kilowatt generating units to be built jointly by China and foreign companies with China playing the main role, and the Daya Bay Nuclear Power Plant in Guangdong, with two 900,000-kilowatt generating units and their nuclear reactors to be built with imported technology and equipment, will also get under way in the Seventh Five-Year Plan period.

He said: When all these projects are completed, they will form a nuclear power generating capacity of 3.3 million kilowatts and will have an estimated annual output of about 20 billion kilowatt-hours, which will help solve China's energy shortage.

He pointed out: In developing nuclear power, China will draw on the experience of foreign countries and use the advanced pressurized-water reactors.

He said: On the principle of "holding itself responsible to the people and to posterity," the Ministry of Nuclear Industry will strengthen nuclear safety standards and regulations, guarantee the quality of equipment manufactured, construction and installation and make sure that no nuclear pollution can leak out into the atmosphere.

The vice minister also disclosed that research and designing are being conducted in China on the use of nuclear energy for heat, and that efforts are being made to build a small heating reactor during the Seventh Five-Year Plan period.

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CSO: 4013/138

FUJIAN TO CONDUCT NUCLEAR PLANT FEASIBILITY STUDY

HK260217 Hong Kong SOUTH CHINA MORNING POST in English 26 Jun 86 Business Section p 1

[Report by Olivia Sin]

[Text] Fujian plans to conduct a feasibility study on the construction of a nuclear power plant in spite of the controversy surrounding the Daya Bay project.

The deputy director of Fujian's Planning Commission, Mr Xin Shimin, said that although the province has rich hydropower and coal resources, it is considered worthwhile to conduct the study.

The province, like many parts of China, is suffering from a chronic shortage of power supply.

Mr Xin said the study will find out the amount of investment needed and the best location for the nuclear plant.

He agreed nuclear power is a controversial subject and that energy experts in the province have different views about using it.

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CSO: 4010/62

NUCLEAR POWER

ENVIRONMENTALISTS EXPRESS CONCERN OVER DAYA BAY'S REACTORS

HK190317 Hong Kong HONG KONG STANDARD in English 19 Jun 86 p 4

[Report by Katherine Saltzstein]

[Text] A report by the U.S. Congress on nuclear power has shown that the type of plant to be built at Daya Bay, just north of Hong Kong, has many unsafe features, according to environmentalists.

The conclusions in the report were ambiguous but one thing was clear: the nuclear industry is young and many problems remain unsolved.

The report, which was published in February, 1984, was commissioned by Senate and House of Representatives committees. Among the project staff were engineers, scientists and university professors.

Mr Fung Chi-wood, a member of the Joint Conference for Shelving the Daya Bay Nuclear Plant, yesterday said he recently received a copy of the report from friends.

While details of plans for the Daya Bay plant are unknown, Mr Fung said information released indicated that it will be a pressurized water reactor.

According to the report, two-thirds of the reactors operating in the U.S. are pressurized water reactors, which have "good safety and reliability records."

However, "doubts linger about both the safety and reliability" of the light water reactors which, said Mr Fung, include pressurized water reactors.

The report said the design could be improved on or different types of reactors could be used to restore confidence in the nuclear industry.

Two widely-publicized accidents, one at Three Mile Island and the other at Browns Ferry, "underscore the potential for a catastrophic accident."

Safety concerns arise from the possibility of human error and malfunctioning of various components of the plants, the report continued.

Among the major safety problems with the water-cooled reactors is their potential to crack the reactor vessel, especially in older reactors, said the report.

It also said the complexity of the reactors could contribute to accidents and asked if "a similar but equally safe reactor (could) be designed."

"The design of the light water reactor has developed in a patchwork fashion and there are still a number of unresolved safety issues," the report said.

It listed several recommendations to make the light water reactor safer and stated that new designs are now being developed. It also outlined other types of reactors considered safer than the light water reactor type.

"Despite the less than perfect record of the light water reactor, many in the industry are reluctant to abandon it. They argue that they have made appreciable progress along the learning curve that would have to be repeated with an alternative reactor concept."

In a related development, Mr Fung said the Joint Conference is to lobby members of the Basic Law Consultative Committee because of their close working relationship with the Chinese authorities and because members have a strong interest in Hong Kong's future.

The conference has collected 75,000 signatures of those opposed to the construction of the plant, said Mr Fung. It hopes to gather 500,000 signatures by the end of August.

Mr Fung also said the conference planned to invite British experts and Hong Kong's new financial secretary, Mr Piers Jacobs, to take part in a seminar on nuclear energy.

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CSO: 4010/60

DAYA BAY SAFETY MEASURES UNDER REVIEW

HK150310 Hong Kong SUNDAY STANDARD in English 15 Jun 86 p 2

[Report by Chalina Chung]

[Text] China will review safety measures at the Daya Bay nuclear plant in the aftermath of the Soviet Chernobyl disaster which sent alarm signals throughout the world on the potential danger of nuclear plants.

Senior Unofficial Member of the Executive Council, Sir Sze-yuan Chung, disclosed this at a press conference yesterday soon after his return from London earlier in the day.

He said that the general secretary of the Chinese Communist Party, Mr Hu Yaobang, had told him that China would go ahead with the project, but would review the safety measures.

Sir Sze-yuan said he raised this controversial issue with Mr Hu at a reception accorded by British Prime Minister Margaret Thatcher to the Chinese leader during Mr Hu's recent visit to London.

Sir Sze-yuan said that Hong Kong people should not worry about the safety of the Daya Bay nuclear plant as it would include a contingency system designed for accidents such as explosions of the radioactive core.

"The design is not to prevent an accident, as many people will question how accidents can be avoided," Sir Sze-yuan pointed out.

But rather, the construction plan will have a built-in safety system to ensure that radiation does not leak out from the core even if accidents happen, he explained.

Sir Sze-yuan said he understood that a protective shell would be built around the radioactive core, so that in the event of any accident there would be no radiation leaks or meltdown.

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CSO: 4010/58

SUPPLEMENTAL SOURCES

GREATER USE OF SOLAR POWER SEEN IN COUNTRYSIDE

HK270220 Beijing CHINA DAILY in English 27 Jun 86 p 1

[Report by staff reporter Xu Yuanchao]

[Text] Solar power is being developed to boost energy resources in China's remote rural areas which the national power grid cannot reach.

Utilization of solar energy is one of the top research priorities of the current 5-year plan, said Jiang Xinian, director of the Beijing Solar Energy Research Institute.

In addition to domestic efforts, China is cooperating with foreign firms to introduce up-to-date technology for manufacturing solar energy products.

Jiang told CHINA DAILY that his institute had signed a $550,000 contract last month with Petro-Sun International Inc of Canada for solar energy technology and equipment.

The equipment will enable the institute to produce 100,000 square meters of solar panels a year.

The director said the use of solar energy could be divided into two parts--heat collection and electricity generation. Although the project to use solar energy for power was at a preliminary stage, some rural residents have begun to benefit from a pilot project.

A solar energy station equipped with 40 solar cells was set up last month in the village of Caoduogou in Fuping County, Hebei Province. The station will supply electricity to two small mountain villages of 52 households for lighting, cooking, and television, according to Jiang.

China's solar energy resources are rich, particularly in Qinghai, Gansu, Liaoning, Hebei and Shaanxi Provinces as well as Xinjiang, Ningxia, Tibet and Inner Mongolia autonomous regions where the sun shines for 2,600 to 3,000 hours a year.

Solar energy stoves are already being produced in China to help resolve cooking problems in remote northwest regions, according to Tu Yunzhang, a division chief of the Ministry of Agriculture, Animal Husbandry and Fishery.

He said that so far the country had produced 80,000 solar stoves. In Gansu Province alone, 50,000 such stoves are in use.

A solar stove that can boil 5 kilograms of water in 20 minutes can save 500-1,000 kilograms of firewood a year for an average family, or 0.25-0.5 tons of standard coal. Last year, the stoves saved China at least 20,000 tons of coal, he added.

Solar-powered houses, "a growing trend" among rural residents, according to Jiang, use solar energy for space heating in the winter and water heating all year round.

The number of such houses has reached more than 200 (about 80,000 square metres), most of which have been privately built and are in Beijing and Tianjin and in Gansu and Hebei Province.

He said the construction industry should include more solar energy facilities in urban buildings. Putting such solar-powered facilities in a building increases construction costs by about 10 percent per square meter. But "it is acceptable to [well-off] rural residents," he added.

Solar-powered water heaters could provide warm water for hotels, restaurants and processing industries, Jiang said. China has produced a total of 500,000 square meters of solar panels up to now. Last year factories in Beijing produced 30,000 square meters of panels, Jiang said.

He called on factories producing solar energy products to improve quality and reduce production costs so as to increase sales in rural areas.

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CSO: 4010/62

SUPPLEMENTAL SOURCES

INTEREST SHOWN IN SWEDISH 10KW WIND GENERATORS

HK230349 Hong Kong SOUTH CHINA MORNING POST in English 23 Jun 86 Business Post p 5

[Article by Elaine Williams]

[Text] China is to set up its firms factory to make small wind power generators based on a novel Swedish design.

With an energy shortfall, particularly in remote rural areas, the Chinese Government estimates that its annual needs for wind machines generating 1 kW or less is around 30,000 units.

China's state-owned Hua Rui company is cooperating closely with Sviab, a Swedish wind energy specialist which has pioneered the development of low-cost, low-power wind machines.

ASEA, the major Swedish robotics and electronics group, has become a distributor for the Sviab-designed machines, thus giving the smaller company greater access to world markets, where the main competition for wind machines of 1 kW or less comes from Scenceburgh of the United States and Aerovat of France.

Until now, the main developments in wind power have related to large machines capable of generating hundreds of kilowatts and up to several magawatts of power.

Britain, West Germany, Sweden, and the United States all have examples of such large wind power machines.

Sviab's founder, Vicky Johnson, however, opted to go in the opposite direction in search of market growth, deciding the greatest potential lay in wind machines producing 10 kW or less.

Largely from his own resources, Mr Johnson set about developing a wind generator reliable enough to be backed by a 5-year guarantee and capable of a 25-year working life with little maintenance.

Three factors in his design have helped Mr Johnson achieve this objective:

Carbon fiber reinforced plastic blades.

These are both strong and flexible. They absorb much of the violent vibration experienced in high winds, rather than transmitting the vibration into the main body of the generator, a major cause of failure in conventional wind machines.

A mechanism to ensure that the wind generator continues to operate in very high winds.

Most large wind machine designs require costly and complex electronic control systems which shut down the generator in very high winds.

The owners of small devices, however, are normally totally dependent on their machines, so shutdown is undesirable.

Sviab's solution has been to add to its machine a simple vane, not unlike that of a traditional weather vane for showing wind direction.

Depending on the wind speed, the vane changes the angle of the blades relative to the wind direction.

At wind speeds of up to 10 meters per second (m/s) the blades are directly in the wind path.

At higher speeds, the hinged vane starts to move away from the main turbine shaft, thus turning the blades out of the wind.

At wind speeds in excess of 60 m/s--when most other designs have shut down--the blades are at right angles to the wind but can still generate power.

A novel form of electricity generator.

The rotor arm which turns inside the stator to produce power has no windings, as have conventional generators.

The first machine developed by Sviab--capable of generating up to 10 kW--has been operating since 1981 and is linked into Sweden's national electricity grid.

The country's Board of Shipping has started to equip its lighthouses with small Sviab machines.

To date more than 100 of the company's machines have been installed worldwide, including 1 on the Great Wall of China and 3 in Argentina.

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CSO: 4010/62

BEIJING STRESSES 'ADVANCED TECHNOLOGY' IN BATTLE AGAINST WASTE

HK170335 Beijing CHINA DAILY in English 17 Jun 86 p 2

[Article by staff reporter Chen Zhisong]

[Text] Beijing is striving to become an energy-saving municipality. During the next 5 years it will reduce the number of energy-wasting products in use and encourage the production of energy-saving, low-pollution and water-conserving products, an official from the city's energy-saving office said.

Stress will be laid on technical renovation and imports of advanced technology in this field. Meanwhile, the city will strengthen and reform the administrative structure leading the job, Zhang Chuanfu, vice-director of the Beijing Office of Energy-saving, said.

During the past 5 years, Beijing saved energy equivalent to 4.8 million tons of standard coal. Energy consumption for every 10,000 yuan of production dropped from 6.43 tons of standard coal in 1980 to 4.67 tons in 1985, a 28 percent reduction, Zhang said.

In addition, the more than 500 technical renovation projects aimed at conserving power contributed to the saving of 1 million tons of standard coal.

More than 1,970 inefficient industrial furnaces, 40 percent of the city's total, were improved and the fuel tanks of the city's 20,000 Jiefang CA-10B trucks were updated to lessen pollution.

The Beijing No 2 Class Works, by importing a furnace from West Germany, reduced its energy consumption by 40 percent for each ton of liquid glass it produced. Output and product quality also were raised.

Though China is blessed with rich energy reserves--such as its estimated 680 million kW of hydroelectric power, the most in the world--a shortage of energy is slowing the development of its national economy, an official from the city's Energy Conservation Center said.

Chen Bingzhong, director of the center, told CHINA DAILY yesterday that it is long-term national policy to give equal importance to the production and conservation of energy. International factors such as cheap oil prices and

depreciation of the U.S. dollar will not alter that policy, he said.

According to the plan, the country will save the equivalent of 100 million tons of standard coal over the next 5 years.

Beijing, meanwhile, plans to cut its energy consumption by an average of 3 percent each year in the next 5 years while industrial production will increase by an annual 7 percent, Zhang said.

To achieve the aim, certain measures--technical renovation, readjustment of industrial and product structures, and domestic scientific and technological cooperation--are imperative, he said.

The Beijing center is also seeking help from foreign countries in the energy conservation field. Currently under way in Beijing is a seminar on the rational use of energy. The seminar, organized jointly by the center and the Agence Francaise Pour La Maitrise de L'Energie will focus on the rational use of industrial energy, energy conservation in communications and transportation, heat supply networks, reclamation of urban refuse and thermal technology.

Papers will be delivered by 10 French experts during the 5-day seminar.

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CSO: 4010/60

CONSERVATION

FIVE-YEAR RECAP OF INDUSTRIAL BOILER DEVELOPMENT

Shanghai DONGLI GONGCHENG [POWER ENGINEERING] in Chinese No 6, 15 Dec 85 pp 33-40

[Article by Shi Qiangsun [2547 1730 1327]: "The Development of Industrial Boilers in China 1981-1985"]

[Text] I. A Survey of Development

By the end of 1983 the number of industrial boilers nationwide had reached 280,000 with 470,000 steam tons, or, according to another source, there were 250,000 boilers with 530,000 steam tons. They should be more or less in this range. Over 200 million tons of raw coal are consumed annually.

The number of industrial boiler makers in China was readjusted from over 500 in 1981 to 214 in 1984 which were qualified to apply for production permits. After more than 2 years of double checking and spotchecking, production permits will be issued to those plants which meet conditions. In 1983, output of the industry as a whole was about 66,000 steam tons and over 30,000 boilers. Along with the growth of the national economy and improvement in the people's living standard, installed capacity of industrial boilers will continue to expand and it is expected to double by the end of this century. Currently, the main industrial boiler products are divided into eight subcategories: hand-fired boilers, chain-grate boilers, reciprocating boilers, spreader boilers, fluidized-bed boilers, pulverized coal fired boilers, gas-oil fired boilers, and hot water boilers. There is a total of 77 varieties, of which 17 are chain-grate boilers which have the most. Based on the quantity of evaporation, chain-grate boilers make up more than 60 percent of the total quantity of evaporation.

Before describing the development in recent years, it is necessary to review briefly the development of industrial boilers in China. Since current product development has its own historical background, a brief review will help us understand present circumstances.

Industrial boilers in China began to develop in the early 1950's. During the more than 10 years until the early 1960's, the main products were modeled on foreign ones which are divided into the header and bent-tube types; the American horizontal external fired return fire-tube type; and the Soviet

model K and model DKB. These boilers can still be used. Their main feature is that they all use high-grade coal as the design coal, their tube boilers come in bulk, and those with a capacity under 4 tons per hour are hand-fired. Their heat efficiency is low and automatic control instruments are almost nonexistent. Beginning in the 1960's, as steel materials were in short supply and old designs did not meet current needs, China gradually designed on its own with the guiding ideology of economizing on steel products. Particularly prominent among low capacity products was the development of packaged water and fire tube boilers. This type of boiler is formed by attaching water-cooled walls to external fired horizontal return fire-tube boiler or the HRT model. It was extensively used in the early 1970's because it has a compact construction and is easy to manufacture. Chief among water-tube boilers are the double horizontal chain-grate boilers, but there is also the double vertical barrel model D layout and construction. In the later part of the 1960's, China entered the stage of complete self-designing, and typical boilers with a capacity between 1 and 4 tons per hour are packaged water and fire tube boilers, of which a few are the double vertical barrel type. Boilers with a capacity of 6 tons per hour or higher are the double horizontal barrel type. The design coal is primarily high-grade bituminous type and varieties including anthracite, lean coal, and brown coal are also derived.

After 1970 there was shortage of fuel coal supply, the quality of coal declined and departments using industrial boilers carried out boiler transformation one after another. After they were delivered to the consumers, factory made boilers suitable for using high-grade coal were refitted, resulting in considerable waste. In order to suit current circumstances, after 1976 the industrial boiler industry vigorously developed boilers for burning bony coal. By the end of 1979 a total of 56 standards had been developed, most of which were fluidized-bed boilers but also included the new types of reciprocating and chain-grate boilers. Great results were obtained in the development of gangue fluidized-bed boilers with a combustion calorific value below 2,700 kilocalories per kilogram. In 1980, along with the readjustment of industry, the quality of coal was improved and orders for boilers that burn bony coal became few. The ash extraction density of fluidized-bed boilers is high, the performance of ash extractors in the country is poor and pollution is severe. The fuel coal must be crushed and screened, and environmental and sanitation conditions are very poor. Consequently, many consumers have stopped using fluidized-bed boilers. However, they are still used in coal mines and areas with bony coal, and recently there is a trend toward an increase. Coal mines annually discharge large quantities of gangue, and fluidized-bed boilers are the only boilers that can burn gangue of such low caloric value. Consequently, fluidized-bed boilers still have a considerable market in this area. There remains a great deal of work to be done in complementary auxiliary equipment, particularly in the comprehensive utilization of ash extractors, crushers, and ash. The foregoing is a brief survey of the development of industrial boilers in China prior to 1980.

After 1980, industrial mining enterprises were readjusted and restructured, the quality of coal in coastal cities increased, but due to a nationwide energy shortage and inadequate supply of coal, locally produced low-grade

coal also entered the market. As a result, the quality of coal used by industrial boilers remained not too stable, generally centering on bituminous coal of medium or higher grades. Before 1980 industrial boilers developed products for high-grade and bone coal but lacked products for medium-grade coal, so that after 1980 the industrial boiler industry decided to develop products for medium-grade coal (with a calorific value of 3,700-4,700 kilocalories per kilogram), and conduct joint design under the leadership of the Electrical Engineering Bureau of the Ministry of Machine-Building Industry. The types of boilers adopted can be summarized under the following four categories:

(1) Two types of hand-fired boilers have been developed for capacities of 0.2 ton per hour and 0.5 ton per hour. One is the open-flame return combustion boiler and the other is the double layer stoker.

(2) A new packaged inclined barrel boiler system has been developed for capacities of 1 and 2 tons per hour, such as shown in Figure 1.

(3) A new assembly water tube system has been developed for capacities of 2 and 4 tons per hour. This is the vertical double barrel chain-grate type of boiler, as shown in Figure 2.

(4) For capacities of 6, 10, and 20 tons per hour, the original horizontal double barrel chain-grate boilers are still used, as shown in Figure 3.

The boiler safety regulations issued by the Ministry of Labor and Personnel in 1980 provided that boilers with a capacity above 1 ton per hour must be mechanically fired. But due to the cost, materials, conditions of use and other objective reasons, those under 1 ton per hour at the present stage of hand-fired boilers still need to go through a period of transition. Two types of boilers, the open-flame return combustion boiler and double layer stoker have been developed based on the society's experience in boiler transformation. Judging from 2 years of actual operation they are still not too ideal and the basic shortcoming remains that they are hand-fired. Open-flame return combustion boilers have already been improved into a draw-plate lifting structure which can be operated and used continuously. Double layer stokers still have some problems in their structural design and method of operation while their efficiency is low.

The second and third types of boilers were developed to deal with the unsafe and easy burning of drum wrapping at the lower section of barrels of water and fire tube types of packaged boilers which are manufactured in relatively large quantities. The efficiency of the second type of packaged barrel boiler system still maintains an efficiency of 76 percent or higher after 1 year in operation. Their output not only assures specified parameters but they also have excess load surplus which are welcome by consumers. The third type of boilers with capacities of 2 and 4 tons per hour are water-tube assembly sets. They are safe and reliable during use, but the work volume of heavy boiler wall installation is large. With the exception of consumers in mountainous and inland areas where transportation is difficult, the general preference is the packaged construction or assembly boiler with

a very high degree of assembly. Small capacity packaged water-tube boilers generally use a vertical double barrel layout. Vertical double barrels can be further divided into two types: one resembles model DKB in mid-barrel, the other has a model D arrangement on one side of the barrel. Judging from the development trend of industrial boilers at home and abroad, double-barrel boilers with convection beam arrangement on one vertical side and a stoker arrangement on the other side are extensively used. The structure can therefore be more compact, serialization is made easy, the barrel can be lengthened at any time with the increase in capacity, and the corresponding increase in the barrel's steam-water dividing section assures the quality of steam. The fourth type is the horizontal double barrel chain-grate boilers. This type of boiler was initially modeled on the model D of Czechoslovakia which had a capacity of 20 tons per hour. Later, China successively designed by itself the two capacities of 6 and 10 tons per hour with double layer layout and heavy boiler walls. The operation of this type of boiler satisfies consumers though metal consumption is high, boiler houses must be tall and investment is big. The present joint design has given consideration to the long period of time it takes to develop new structures for large capacity products. In order to stress developing products using medium-grade coal, matured types of boilers are still being used in order to accelerate progress.

For the appraised heat efficiency of jointly designed products that use medium-grade coal, with the exception of hand-fired boilers which is between 62 and 65 percent, all other products are 76 percent or higher. Results of retesting packaged inclined barrel boilers with capacities of 1 and 2 tons per hour after 1 year in operation show that they still maintain an efficiency of 76 percent or higher.

In the period between 1980 and 1984, many manufacturers developed quite a few of their own new products besides those that are jointly designed. In 1984 alone 29 varieties of new products were appraised. Judging from these new products the following features can be seen: 1) the variety of water-tube boilers with small capacities between 2 to 4 tons per hour has increased, among which are the packaged and assembly types. Moreover, water-tube single layer layout and construction with a capacity of 6 tons per hour has been developed. 2) The variety of reciprocating boilers has increased. Because of the ease of manufacturing, low dust content in smoke, suitability of fuel coal, capacity has been developed from 0.5 to per hour to 10 tons per hour. Two types of reciprocating stokers are currently being manufactured, the stepped and horizontal types. 3) The variety of hot water boilers has increased. 4) With the increase in the variety of medium-grade coal, their heat efficiency is generally higher than older products. 5) Most of the products are complemented with control boxes, basically implementing the Ministry of Machine-Building Industry's 1980 documents on provisions concerning complementary equipment.

With the exception of steam boilers, five standards of joint design have been made for hot water boilers. Specifically they are as follows:

(1) RSL 250 pressure 7 kgf/cm^2, temperature of water discharged 95°C
(2) DZL 360 pressure 13 kgf/cm^2, temperature of water discharged 130°C
(3) RZL 600 pressure 7 kgf/cm^2, temperature of water discharged 110°C
(4) DZL 600 pressure 10 kgf/cm^2, temperature of water discharged 130°C
(5) DHL 1200 pressure 13 kgf/cm^2, temperature of water discharged 130°C

Apart from the five types of products mentioned above, quite a few new products have been developed by various manufacturers in recent years. At present, there are various types of hot water boilers with capacities of 600,000, 1.2 million, 2.4 million, 3.6 million, 4 million, 6 million, 9 million, and 12 million kilocalories per hour.

In order to conserve energy, in the future we still need to vigorously develop hot water boilers and gradually replace steam with hot water concentration for the supply of heat. Therefore, other than perfecting existing small capacity hot water boilers, we should also develop those with 25 million to 50 million kilocalories per hour and even bigger coal-burning hot water boilers in order to initiate conditions for making overall plans to construct large integrated thermal network.

In view of the improvement of industrial boiler products in recent years in terms of variety, quality, and standards, the following aspects can be summarized:

1. Leaders of the ministry and bureau have stressed the work on standards and quality. Since 1980 they have strongly stressed the work on standards, convened a series of work conferences on industry standardization and have vigorously promoted the adoption of international standards. Currently there are over 30 state and ministerial standards in China's industrial boiler industry. The various standards on design, manufacturing, installation, thermal engineering tests, complete auxiliary machinery, operation, and maintenance are basically complete. The substance of these standards are basically similar to those in industrially developed countries. The work on issuing permits jointly carried out by the Ministry of Labor and Personnel and Ministry of Machine-Building Industry has played a significant role in the improvement of the quality of products of manufacturers.

2. Various departments in concern stress the work of scientific research and technical development of industrial boilers. The State Economic Commission, State Science and Technology Commission, State Supplies Bureau Ministry of Machine-Building Industry, colleges and universities, manufacturers, consumers, research institutes, as well as concerned departments in charge of energy conservation at the provincial and municipal levels all actively support S&T development of industrial boilers. At the 1982 annual meeting of the Society of Power Engineering, a large number of essays described the work in this area. Here we summarize scientific research and development in the last 2 to 3 years as follows:

(1) Research and testing of chain-grate stokers have primarily focused on the three areas of airtight sealing, air mixing, and stoker construction.

Airtight sealing and air mixing are the key to increasing stoker combustion efficiency. During 1983-1984, plants and institutes concerned launched tests and research on vertical air mixing and airtight sealing in small chain-grate stokers, developed new airtight sealing boards, carried out a large number of cold-state tests, and performed thermal engineering determination of comparative tests on heat efficiency before and after refitting. Boiler efficiency was raised by 2 to 3 percent. The achievements of these tests will be popularized once they are appraised. In recent years a type of large stoker has been developed and are being used in joint design. After more than a year of operation and testing, they have been able to meet the requirements of use. They are characterized by their higher intensity than the original small stokers, low metal consumption, and a low leakage of coal. The problem is that sometimes their air vents can easily become blocked up. To deal with this shortcoming, the Guizhou Boiler Works developed an improved construction which is currently being tested. Chain-grate stokers are the most extensively used stokers in China. Their performance has a significant impact on the results of energy conservation of industrial boilers. The efficiency of new jointly-designed products with capacities of 1 to 2 tons per hour is higher than that of the old products largely because of improvement in stoker construction. In view of the quality of chain-grate stokers which are currently mass produced in China, both vertical and lateral airtight sealing have a serious air leak problem which results in difficulty to regulate combustion. It can be seen from large numbers of thermal engineering test reports that the excess air coefficient is around 1.8 to 2. Outside China, this excess air coefficient of chain-grate boilers is controlled at around 1.5. This requires a long period of study, and in order to assure safe and reliable operation in thermal state without jamming dead and jamming while maintaining the lowest tolerance clearance, it is necessary that the four areas of design, technology, testing, and inspection are closely coordinated. We must continuously improve construction and gradually perfect it. Similarly, apart from the problem of airtight sealing, reciprocating stokers still have the problem of stokers burning out. At present, it appears that this problem needs to be tackled by the quality of materials. Manufacturers in concern have undertaken to study this problem which is expected to complete this year. In short, manufacturers, research institutes, colleges and universities have done a great deal of work on layered combustion stokers in recent years and have promoted the improvement of products. However, we can only say that this is just the beginning, initial results are barely in sight and a large deal of work remains to be done before they are truly reflected in specific products.

(2) In 1981, Chongqing University and Chongqing Boiler Works launched tests and research on the application of threaded pipes in coal-fired smoke tube industrial boilers. They studied Reynolds numbers between 6,000 to 30,000 hours, the flow and heat transmission character of air in a single-head threaded pipes, and performed industrial comparison tests on a KZL4-13-A II boiler. After 3,000 hours of continuous operation and observation, the inside wall did not show any noticeable wear and tear. Ash accumulation was not as serious as that in light pipes. Appraisal was made at the end of 1983 and it was affirmed that after using the threaded pipes in the secondary

return-stoke in the above-mentioned 4-ton per hour boiler, the heat absorption capacity increased by about 25 percent, which led to a drop in smoke temperature by 26° to 28°C, and because of the decrease in smoke loss, the original boiler efficiency was increased by 2.5 percent. It will take a long period of testing before comprehensive economic results are available.

(3) Definite progress has been made in the development of industrial boiler combustion automatic control in recent years. In Shanghai, industrial boiler combustion automatic control began at the Shanghai No 5 Chemical Fiber Plant and Minxing Chemical Plant. Subsequently, Shanghai No 5 Steel Works and others used DDZ II instruments. The DDZ II instrument is a more matured instrument which can completely take care of automatic control of industrial boiler combustion and feed water, though the price is relatively high with each set costing approximately 50,000 yuan. The cost of industrial boiler automatic control device based on international averages is around 10 to 15 percent of the total price of the boiler. The cost ratio of automatic control is somewhat higher for small capacity units such as boilers under the capacity of 10 tons per hour. At present, a boiler with a capacity of 4 tons per hour is sold for around 80,000 yuan and one with a capacity of 10 tons per hour for 180,000 yuan. Using the DDZ II instrument at 27 to 60 percent of the total cost is too expensive. It is worthwhile only if we install DDZ II instruments on boilers with a sale price of 50,000 yuan and a capacity of at least 35 tons per hour. In 1983, the Industrial Boiler Bureau and manufacturers in concern developed a special combustion automatic control instrument for small industrial boilers. In the course of operation it fully and automatically regulated the air-coal ratio so that under a 15 to 20 percent load fluctuation it automatically regulated the combustion quantity and steam pressure could basically be maintained within a variation of ±0.5 kgf/cm. This control system included oxygen fine adjustment automatic control, chamber negative pressure control, stoker ungraded governor mechanism, actuating mechanism of the air blower and intake device, stress pressure regulator, as well as boiler combustion automatic control instrument (the main control instrument).

In early 1984 this set of equipment was installed in the Shanghai No 5 Rubber Shoe Plant and remained satisfactory after half a year of operation. The main problem was the poor quality of the oxygen test instrument. Automatic control attachment systems used for small industrial boilers in Britain also utilize the same principle. After visiting our installation, the chief engineer of Robey Co., a large industrial boiler plant in Britain, indicated that the system they use is similar to ours. The principle of the system currently uses boiler steam pressure to drive the corrugated pipes of pressure ratio regulator. The extension or contraction of the corrugated pipes regulate the slide arm of slide-wire electrical resistance which changes the value of electrical resistance. This then changes the electrical resistance signals into voltage to output signal and control the size of opening of the air gate and stoker speed in order to obtain the optimum air-coal ratio. Outfitting a 4-ton per hour boiler with a complete set of automatic control costs around 15,000 yuan. For a 4-ton per hour boiler that costs 80,000 yuan this constitutes 18.8 percent of the total cost and is already

quite high. Recently, Beijing Automatic Instrument and Meter Plant has developed microcomputer control, and the future of its popularization and development is largely determined by prices and costs. Industrial boiler combustion automatic control is an inevitable trend of development and the key is the quality and prices of instruments. We believe that development of this aspect in the future requires joint research among design and technical personnel of the instrument and meter industry, industrial boiler industry as well as the two ministries to develop special combustion automatic control devices and test instruments for small industrial boilers which are of low cost and reliable quality. In the near future, we must primarily improve and upgrade the performance and quality of oxygen measuring meters, coal measuring meters and pressure transducers. In the long run, it is hoped that we can develop a quick test instrument for carbon content in boiler slag. The realization of this instrument will be of enormous help to combustion automatic control devices.

(4) In recent years there have not been any new developments in water treatment of industrial boilers in the system, but there has been considerable growth in the extent of popularization. Prior to 1980, approximately 50 percent of the industrial boilers adopted water treatment. According to recent figures, in coastal areas industrial boilers that have water treatment make up about 70 percent. The number of production plants of water treatment equipment have greatly increased. In Wuxi alone there are more than 40 of them and it is estimated that there are at least 600 nationwide. This is favorable to popularizing water treatment of industrial boilers, but the capability of scientific research and technical development in water treatment remain weak and few new products have been developed. Although we have not seen too many water treatment equipment for small boilers abroad in recent years, three or four plants have separately imported equipment from manufacturers in the United States and New Zealand. They are characterized by a high degree of automation and they generally use electromechanical multi-unit valves. As many as four different types have already been imported by China. Based on the achievements of the tasks of Shanghai's colleges, universities, and institutes in concern, the Industrial Boiler Institute and Jiangyang Boiler Auxiliary Machinery Plant have jointly developed and manufactured program control multi-unit valves for boilers with a capacity of 4 tons per hour, modeling on those from abroad. In actual operation, the problem is the unstable quality of individual parts. We believe that the production and development of program control multi-unit valves is a key aspect of improving industrial boiler water treatment equipment. Even less work has been done in the problem of water feed and oxygen removal in industrial boilers. In this respect we should import some sample machinery and speed up progress in the task of oxygen removal.

(5) After 1980, industrial boiler makers have added ash extractors to all boiler products in accordance with the provisions of the Ministry of Machine-Building Industry. After a period of operation and testing, these ash extractors have played a role in curtailing pollution in operation and practice, but their efficiency is low at approximately 80 percent. In recent years quite a few units have successively developed a number of

new cyclonic ash extractors that have a higher efficiency. In order to achieve even more rational selection of auxiliary devices, the Ministry of Machine-Building Industry and the Ministry of Urban and Rural Construction and Environmental Protection jointly organized departments concerned to conduct in Shanghai, Wuhan, Tianjin, Beijing, and Nanjing comparative determination and appraisal of 26 ash extractors of different specifications according to a unified test method. Finally eight models, XZY, XZS, XZZ, SG, XZD, XDX, XS, and XND were set as the basis of auxiliary outfitting. Of these ash extractors, XZY and XZS are the exceptions that give a hand-fired boiler efficiency of 80 percent, the others are close to 90 percent. They can be regarded as China's second-generation cyclonic ash extractors. Cyclonic ash extractors are still the main type of ash extractors used by small coal-fired boilers in industrially advanced countries at present. According to the contact between our Shanghai Industrial Boiler Research Institute and the Lentjes Boiler Workers of West Germany and Robey Boiler Works of Britain, the efficiency of the cyclonic ash extractors they use are around 95 percent. Therefore, we still have a great deal of work to do in this area. The diameter of the Whirlwind of Britain is around ϕ 200 and that of West Germany is smaller. Their casing is of cast finish, and both their precision and wearability are good and they deserve to be used for reference.

(6) In recent years, the thermal engineering test capability of industrial boiler manufacturers has improved. As arranged by the State Economic Commission, industrial boiler test centers have been built in six boiler plants in Anshan, Beijing, Chongqing, Jinan, Xi'an, and Changsha which are responsible for providing assistance to thermal engineering tests of manufactured products in their own greater regions. At present, three centers have been checked and accepted and efforts are made to check and accept all of them this year. Currently many fuel corporations in large cities undertake tasks of testing, but individual labor departments also carry on the professional work in efficiency tests. Because the State Planning Commission and State Economic Commission stress industrial boiler heat efficiency tests, the extent of testing of industrial boiler products in China has greatly increased, which has played a significant role in upgrading and improving products. In the future we still need to strengthen the setup for fuel analysis and laboratory tests.

(7) In recent years, fuel supply departments have carried out measures of power mixing of coal in several large cities so that the fuel coal calorific value and volatile are relatively stabilized within a certain range, which is beneficial to energy conservation and efficiency of industrial boilers and raising efficiency. At present, the key to the problem of coal mixing is particle size. For layered combustion, uniformity of particle size is very important. Currently the quality of screens in coal distribution yards is very poor. Nominally it is specified that fuel coal particles must not exceed ϕ 50 mm in size, but actually many are large lumps greater than ϕ 50 mm. The results will be even more tangible if fuel supply departments can strictly control particle size.

II. Existing Problems

Since 1980, definite results have been achieved in product development in China's industrial boiler industry, but there is still a gap between the demands of state energy conservation and advanced standards in the world. Many problems relating to present variety and quality remain exposed.

Last year when the two ministries conducted spot checking and double checking for the issuance of production permits, they found that the quality of products had declined among many manufacturers which had been checked and were thought to be qualified in 1983 while that of small manufacturers which initially did not qualify had all improved. Even some individual long-time manufacturers in the industry have serious problems of quality. This clearly shows that quality control work among China's industrial boiler makers is not stable and solid. With the supply of industrial boilers lower than the demand, it is not easy to do a good job in product quality conscientiously and in earnest. Take the manufacturing of chain-grate stokers as an example, China has a history of more than 30 years in the making of chain-grate stokers but so far not a single industrial boiler maker can manufacture chain-grate stokers that have a high level of performance and quality. The causes are numerous. Objectively speaking, a main reason is that "somebody will buy what is produced" and the manufacturers can be "satisfied" with the present standards of products because they mainly have output value and profits in mind. Tests, upgrading, and improvement most of the time bring no advantage to the manufacturers, and only when there are serious quality problems will they be compelled to do some tests. As a result, besides intensifying industry quality inspection, we must also intensify technical exchange in the industrial boiler industry at home and abroad, strengthen quality control, intensify instruction on quality, improve ideological understanding, commend and publicize manufacturers which truly perform well in technical development and quality control, summarize experiences and popularize them, and speed up the four modernization program to realize socialism in the motherland.

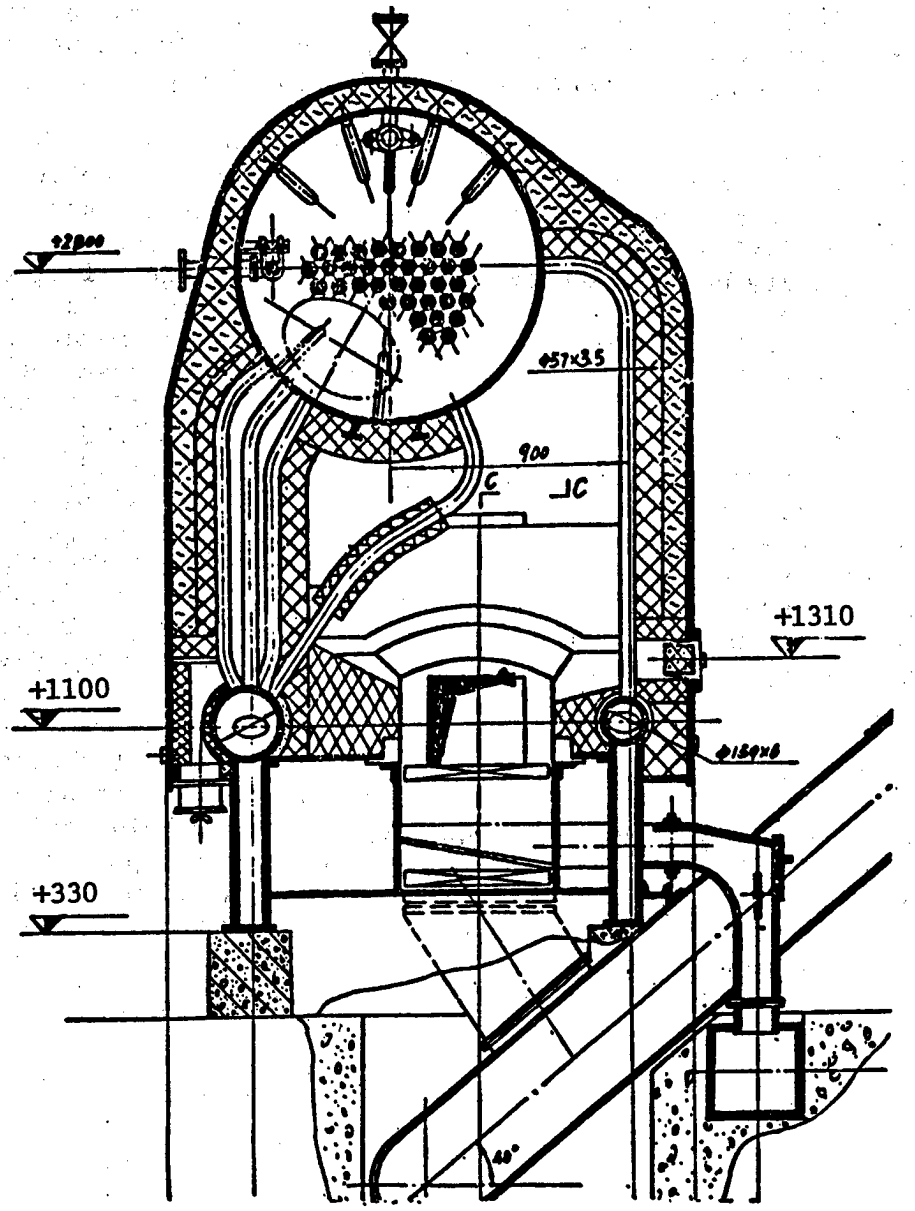

Figure 1. New Type Packaged Inclined Barrel Boiler

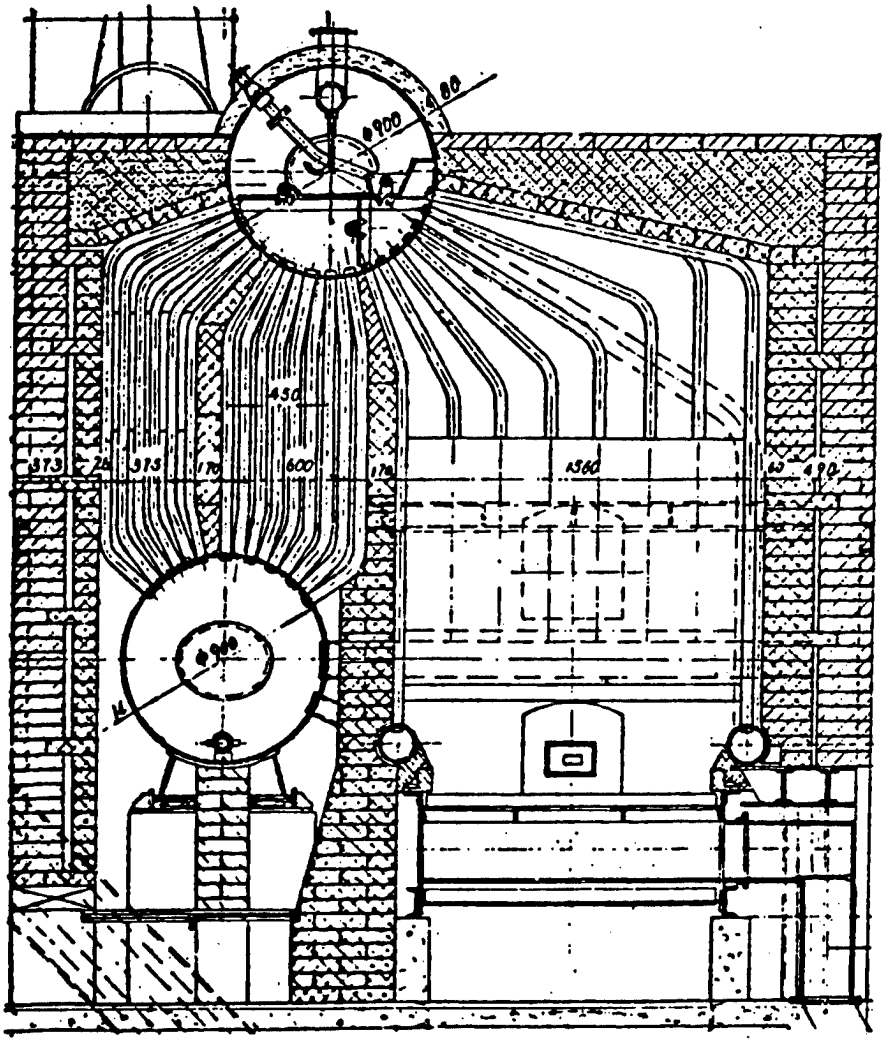

Figure 2. Vertical Double Barrel Chain-Grate Boiler

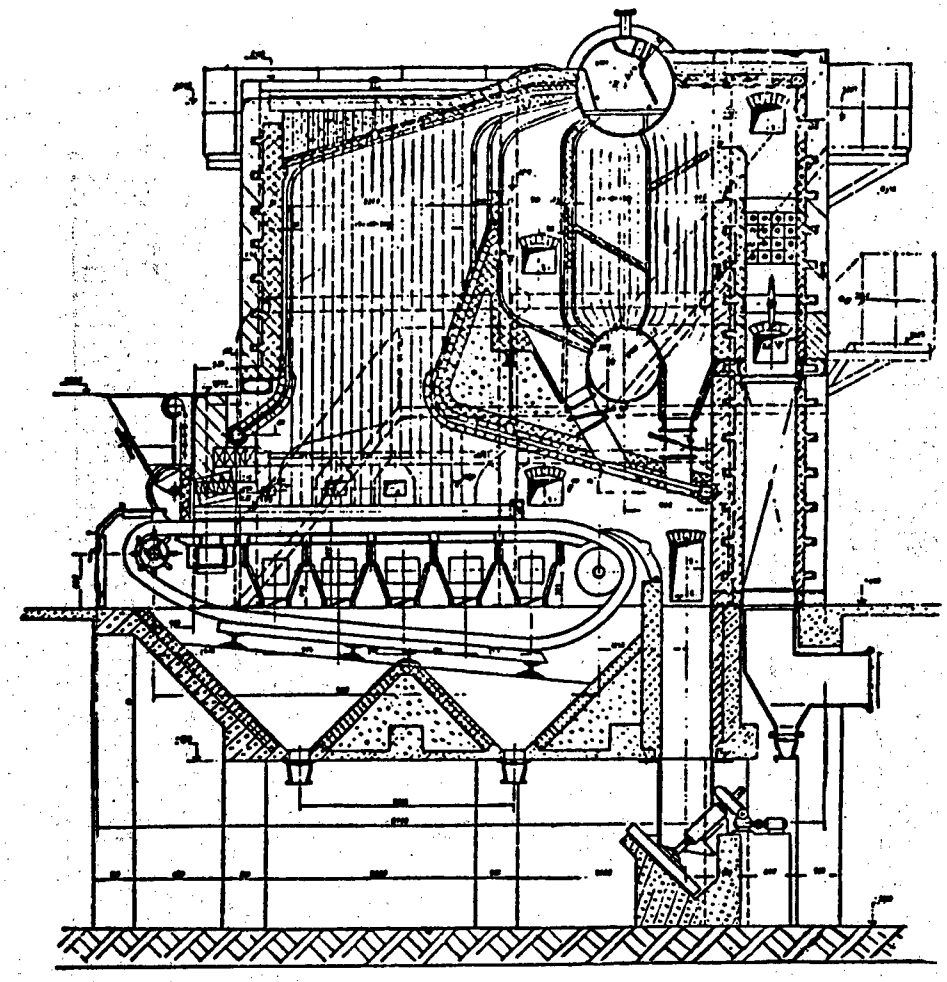

Figure 3. Horizontal Double Barrel Chain-Grate Boiler

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